

**WOMEN'S KNOWLEDGE, BEHAVIOURS AND DIETARY PATTERNS
CONTRIBUTING TO EXCESS WEIGHT GAIN IN PREGNANCY**

By

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List of Abbreviations

ACOG	American College of Obstetricians and Gynecologists
ANCOVA	Analysis of covariance
ADA	American Diet Association
BMI	Body Mass Index (weight[kg] / height ² [m])
CDC	Centre for Disease Control
CG	Control Group
CHO	Carbohydrate
CHMS	Canadian Health Measures Survey
CSEP	Canadian Society for Exercise Physiology
CVD	Cardiovascular disease
CCHS	Canadian Community Health Survey
DRI	Dietary Reference Intakes
GDM	Gestational diabetes mellitus
GWG	Gestational weight gain
ICC	Inter Correlation Coefficient
IG	Intervention Group
HALO	Healthy Active Living and Obesity Research Group
HCP	Health Care Provider
HBM	Health Belief Model
HBW	High Birth Weight
IOM	Institute of Medicine
Kcal	Kilocalories
LGA	Large for gestational age
MOM	Maternal Obesity Management trial
M-Health	Mobile Health
OB	Obese
OW	Overweight
MVPA	Moderate to Vigorous Physical Activity
PA	Physical activity
PES	Pregnancy Experience Scale
PRO	Protein
PPWR	Postpartum weight retention
PWGAS	Pregnancy Weight Gain and Attitude Scale
RCT	Randomized Control Trial
RDA	Recommended Daily Allowance
SCT	Social Cognitive Theory
SDH	Social Determinants of Health
SES	Socioeconomic Status
SGA	Small for gestational age
SOGC	Society of Obstetricians and Gynecologists of Canada
WHO	World Health Organization

Abstract

Background: The number of women considered overweight (OW) and obese (OB) in Canada has steadily increased over the past thirty years [1]. In addition, there has also been a rise in the amount of weight women gain during pregnancy. Many adverse pregnancy outcomes are associated with maternal overweight, obesity and/or excessive gestational weight gain (GWG), which have been widely studied and reported. In 2009, the Institute of Medicine (IOM) developed healthy GWG guidelines, based on trial and observational evidence, that provide BMI-related weight gain targets [2]. This evidence has shown that weight gain within the guidelines results in better health outcomes for the mother and baby, during pregnancy, as well as postpartum.

Objectives: (1) To address diet quality and patterns using data collected from the Maternal Obesity Management (MOM) Intervention Trial, and (2) Develop and validate a comprehensive web-based questionnaire that can be used in a future study to examine women's knowledge of the IOM GWG guidelines, dietary recommendations, physical activity (PA) practices, as well as other lifestyle habits.

Methods: (1) *Exploratory pooled analysis of dietary data from Maternal Obesity Management (MOM) trial* - To identify diet quality of women who exceeded (EX) versus did not exceed (NEX) the 2009 IOM pregnancy weight gain targets. Participants (n=50) completed 7-day food records at 3 points during pregnancy (baseline (V1: 12-20 weeks), between 26-28 weeks (V2) and between, 36-40 weeks (V3). Data were analyzed in ESHA Food Processor Program and SPSS (version 13) to see if there was any difference found in diet between EX and NEX women. (2) *Development and validation of a comprehensive maternal health questionnaire aimed to establish gaps in women's behaviours and perceptions of the IOM GWG guidelines* - An expert

panel was consulted in the development of questionnaire constructs and items to gain content validity of the questionnaire. After multiple phases of questionnaire development and revisions, a 14-day test re-test validation pilot study was conducted to establish test re-test validity.

Results: (1) In the EX and NEX analysis, significant decreases were found in total energy intake, including fat and protein, across pregnancy in the NEX GWG group. Significant group-by-time interaction was also found for energy intake and protein. (2) Most constructs included in the electronic maternal (EMat) Health questionnaire all proved to have sufficient test re-test validity via correlation analysis.

Conclusion: In order to address the knowledge gaps regarding excess weight and changes in dietary habits during pregnancy, it is beneficial to explore pregnant women's knowledge and behaviours regarding these issues and collect information on what women report as barriers and facilitators to gestational weight management. The conclusions drawn from both of these studies may inform future interventions, as well as indicate where further education strategies are needed.

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Contribution of Authors

This thesis presents the work of Ms. Holly Ockenden in collaboration with her Thesis Supervisor, Dr. Kristi B. Adamo, and contributions from the following co-authors: Dr. Audrey Giles, Danilo F. DaSilva, Dr. Denis Prud'homme, Dr. Eric Doucet, Dr. Gary Goldfield, Dr. Irene Strychar, Dr. Katie Gunnell, Dr. Kara Nerenberg, Shanna Wilson, and Taru Manyanga.

Manuscript 1: *Dietary Analysis of Excessive and Non-Excessive Weight Gain in Participants from the Maternal Obesity Management (MOM) Trial.* Dr. Adamo, Holly Ockenden, Drs. Prud'homme, Doucet and Strychar as well as Shanna Wilson were responsible for the initialization and conceptualization of this portion of the project. The data collection, data entry, statistical analysis, interpretation of results, and writing of the manuscript were performed by Holly Ockenden. All authors will be asked to review and agree to the finalized content of this manuscript before publication. This manuscript has been formatted and will be submitted to the *Journal of Nutrients*.

Manuscript 2: *Development and Preliminary Validation of a Comprehensive Questionnaire to Assess Women's Perception of the Current Weight Gain Guidelines during Pregnancy.* Dr. Adamo, Holly Ockenden, Dr. Giles, Dr. Nerenberg and Dr. Goldfield were responsible for the initialization and conceptualization of the questionnaire development as part of the expert panel. The questionnaire REDCap development, validation study, statistical analysis, interpretation of results, and writing of the manuscript were performed by Holly Ockenden. All authors will be asked to review and agree to the finalized content of this manuscript before publication. This manuscript has been formatted and will be submitted to the *International Journal of Environmental Research and Public Health*.

The Introduction, Literature Review, General Discussion and Appendices were completed by Holly Ockenden. The final content of this thesis was complemented by suggestions and editorial comments from Dr. Adamo.

Statement of Originality

I hereby certify that all of the work described within this thesis is the original work of the author. Any published (or unpublished) ideas and/or techniques from the work of others are fully acknowledged in accordance with the standard referencing practices.

Holly Ockenden

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Chapter 1

THESIS OVERVIEW

1.1 SUMMARY OF POPULATION AND PROBLEM

Obesity is a global problem and largely considered a preventable disease [3]. According to the World Health Organization (WHO), more than 1.9 billion adults are overweight (OW), including over 600 million men and women considered obese (OB) [4]. We now live in a world where OW and OB are responsible for more deaths than underweight [5]. Paralleling this trend of increased prevalence of excess weight in the general population, the number of OW or OB pregnant women presenting for obstetric care continues to grow, causing challenges and concerns for health care providers (HCP) [6]. Recent health measure surveys indicate that 48.2% of Canadian women are at a weight higher than considered healthy; this number has increased from 44.6% in 2001[1].

High pre-pregnancy Body Mass Index (BMI) (>25), alone or in combination with excess gestational weight gain (GWG), has been associated with an increased risk of poor pregnancy outcomes, including gestational diabetes mellitus (GDM), preeclampsia, macrosomia and large-for-gestational-age (LGA) newborns, cesarean section and a number of other health consequences [7-9]. The Institute of Medicine (IOM) developed evidence-based GWG recommendations, based on pre-pregnancy BMI cut-points, that reflect the need to mitigate pregnancy-related complications [2]. Unfortunately, over 60% of women gain in excess of these guidelines while pregnant, further exacerbating health issues related to obesity in women [10, 11]. Weight gain in excess of these recommendations has been identified as a risk factor for long-term post-partum weight retention (PPWR) as well as future potential weight issues in the infant [12-14].

Current reports have predicted that the number of deliveries to women with pre-pregnancy obesity is projected to increase by 123% from 2009 to 2017, and by 191% from 2009 to 2035 [15] , thus magnifying the cycle of obesity and its health consequences.

The increased prevalence of, and serious health consequences related to high GWG demonstrate the urgent need to identify risk factors and modifiable behaviours in order to improve maternal health and prevent excess GWG in pregnancy. There is a plethora of research describing complications related to excessive GWG, but only a small number of studies aim to improve IOM GWG guideline compliance by improving knowledge, addressing modifiable risk factors, and collecting information on potential barriers women face. This thesis focuses on factors contributing to healthy pregnancy weight gain (i.e., energy intake and dietary patterns) as well as women's perceptions and health behaviours related to GWG with the hope of understanding the reasons why women continue to gain outside the recommendations.

1.2 HYPOTHESES

1. Guideline concordant gestational weight gain is associated with macronutrient dietary intake within Health Canada's recommendations during pregnancy.
2. The newly developed comprehensive maternal health questionnaire will demonstrate content validity via an expert panel review and initial test-retest reliability.

1.3 OBJECTIVES

1.3.1 Specific Objectives of this Thesis

A) To examine dietary intake patterns across pregnancy by completing dietary analyses using 7-day diet record data from participants in the Maternal Obesity Management (MOM) Trial.

- Manuscript 1 describes an exploratory-pooled analysis of participants from the MOM trial whose primary objective was to identify potential differences in dietary intake patterns of women who exceeded versus did not exceed the IOM pregnancy weight gain targets.

Once we examined the MOM trial dietary data and identified the lack of intervention success in effecting change in dietary patterns and further examined the relationship between dietary patterns and GWG in the women more broadly, it was determined that a tool was needed to further assess women's knowledge and perception of the current weight gain guidelines, as well as other barriers to achieving optimal health throughout pregnancy.

B). To develop and perform preliminary validation and test-retest reliability of a comprehensive questionnaire to assess women's attitudes and behaviours surrounding the current weight gain guidelines during pregnancy

- Manuscript 2 outlines the development and validation of the Electronic Maternal (EMat) Health Survey. The aim was to develop a comprehensive web-based questionnaire to examine multiple components of maternal health including; perceptions, attitudes and behaviours regarding the GWG guidelines, pregnancy dietary recommendations, physical activity (PA) practices and other lifestyle habits.

- The *EMat Health Questionnaire* will be used to collect information and assess where knowledge is lacking regarding risks associated with excess GWG in a subsequent, on-going study.

1.4 PRESENTATION OF THESIS WORK

The following Masters of Science conforms to the regulations provided by the University of Ottawa, Faculty of Health Sciences, School of Human Kinetics. This thesis is presented in manuscript style. **Chapter 2** provides a current review of the literature for topic areas related to this thesis (Maternal Obesity, Gestational weight gain, pregnancy diet and physical activity recommendations), knowledge gaps and proposes future work. **Chapter 3** outlines the preliminary Maternal Obesity Management (MOM) trial intervention vs. control group dietary analysis. **Chapter 4** introduces the need for the secondary, exploratory MOM trial analysis comparing women who gained within or exceed weight gain recommendations. **Chapter 5** presents the first prepared manuscript entitled "*Dietary Analysis of Excessive and Non-Excessive Weight Gain in Participants from the Maternal Obesity Management (MOM) Trial*" This manuscript will be submitted to the *Journal of Nutrients* and has been formatted to the journal's requirements. **Chapter 6** is the introduction and need for the development of a maternal health questionnaire. **Chapter 7** is the second prepared manuscript entitled, "*Development and Preliminary Validation of a Comprehensive Questionnaire to Assess Women's Perception of the Current Weight Gain Guidelines during Pregnancy*". This manuscript will be submitted to the journal *International Journal of Environmental Research and Public Health* and has been formatted to the journal's requirements. This thesis will conclude with **Chapter 8**, which provides the reader with a global discussion of the findings, outlines the current on-going study

using the developed questionnaire, and suggests future research ideas and conclusions from the research and topic areas.

Chapter 2

LITERATURE REVIEW

2.1 GESTATIONAL WEIGHT GAIN GUIDELINES

The GWG guidelines have evolved and adapted to the changing health concerns and needs of pregnant women. Weight recommendations for pregnant women were first developed in 1970 to mitigate low maternal weight gain and infant birth weights resulting in a high infant mortality rate [16]. Twenty years later, in 1990, The IOM released more specific weight gain targets, based on pre-pregnancy BMI but did not take into account an upper limit for OB women [17] (Table 1). In 2009 the guidelines were reexamined and updated in response to concerns of the increased number of OW/OB women entering pregnancy and/ or gaining excess gestational weight (Table 2). As in the past, the amount of weight a woman is recommended to gain, continues to be guided by her pre-pregnancy BMI. The updated weight ranges are based on a risk/benefit analysis of the effects of GWG on the mother and infant [18] and weight gain within the recommended limits is thought to improve pregnancy outcomes and reduce a number of health risks in mom and baby [18].

The 2009 IOM guidelines suggest that women who are considered underweight prior to pregnancy gain 12.5-18.0 kg., those that are of normal weight gain 11.5-16.0 kg., and women who are OW or OB gain 7-11 kg. or 5-9 kg., respectively. These guidelines are currently the primary source of GWG information used by healthcare providers in Canada and worldwide.

IOM 1990	
BMI (kg/m ²) (WHO)	Recommended weight gain in kg.
Underweight (<19.8)	12.5 -18.0
Normal weight (19.8-26.0)	11.5-16.0
Overweight (26.1-29.0)	7 -11.5
Obese (>29.0)	At least 6

Table 1: Institute of Medicine gestational weight gain recommendations (1990).

IOM 2009		
Pre-pregnancy BMI (kg/m ²) (WHO)	Total weight gain range in kg.	Rates of weight gain* 2 nd and 3 rd trimester in lbs. (Mean range in kg/wk.)*
Underweight (<18.5)	12.5 -18.0	0.51 (0.44-0.58)
Normal weight (18.5-24.9)	11.5-16.0	0.42 (0.35-0.50)
Overweight (25.29.9)	7 -11.5	0.28 (0.23-0.33)
Obese (includes all classes) (>30.0)	5 -9	0.22 (0.17-0.27)

**Calculations assume a 0.5-2 kg. weight gain in the first trimester*

Table 2: Institute of Medicine gestational weight gain recommendations (2009).

When comparing the 1990 and 2009 guidelines, updates can be found in the weight gain targets for underweight as well as OB classified women. The updated GWG recommendations have been reduced for OB women and increased for women considered underweight. In addition, the updated guidelines provide a weekly weight gain target for the second and third trimesters. A final change was made to the BMI categorizations; they are now based on the WHO cut-off points, whereas in the 1990 guidelines, BMI was based on the Metropolitan Life Insurance tables [17].

Despite the growing number of severely obese women in all classes (obese BMI class I:30-34.9, class II:35-39.9, class III:>40), at the time the committee was updating the IOM guidelines, minimal data were available in the literature that could be used for the development

of weight gain targets for each class of obesity. Therefore, the IOM report called for more research on obese pregnant women in order to provide a basis on which future revisions can include optimal weight gain guidelines in severely obese women.

2.2 PREVALENCE OF EXCESSIVE GESTATIONAL WEIGHT GAIN

Excess GWG has been reported to occur in 50 to over 60% of Canadian women (>18 years) with normal pre-pregnancy BMI [7, 11, 19, 20], and multiple studies have confirmed that women who enter pregnancy OW are 50% more likely to exceed GWG guidelines than are normal-BMI women[40, 75-77]. Reports from women considered OW/OB pre-pregnancy [21, 22] as well as teenage pregnancies [23] indicate these groups experience higher than average weight gain, thus raising additional concerns. As for adolescent pregnancy, research has reported the occurrence of excess weight gain in as many as 66% of obese teens [7, 12]. Knowing that the majority of women are not gaining healthy amounts of weight while pregnant, regardless of pre-pregnancy BMI or age, and that weight gain is exacerbated in high BMI women and in teen pregnancy, some form of mitigation is necessary. Most studies described above have included measured final pregnancy weight; in comparison to self-report weight, which increases reliability of the estimates, although, the studies did use self-report data to calculate pre-pregnancy BMI. The validity of some findings may also be limited by not using representative samples (Caucasian, non-smoking women) or small sample sizes.

2.3 CONSEQUENCES OF EXCESSIVE GESTATIONAL WEIGHT GAIN

A broad spectrum of adverse pregnancy outcomes have been linked to excessive GWG. Well documented complications in the mother include, the delivery of a LGA baby, macrosomia [11, 24], pre-eclampsia, GDM, and caesarean section [18] . For example, a U.S case-control study of 1,145 pregnant women concluded that GDM risk increased with high GWG, particularly

in women with increased weight gain in the first trimester [25]. This risk was further increased in women considered OW or OB prior to pregnancy. In fact, research suggests that high pre-pregnancy BMI not only increases the risk of GDM, but also for all other adverse pregnancy outcomes related to high GWG [26-29].

Independent of pre-pregnancy BMI, high GWG also adversely affects behaviours that promote postpartum weight loss, such as breastfeeding initiation and duration [30-32]. This reduction in health promoting behaviour translates to higher rates of PPWR and, thus, greater increases in body weight before subsequent pregnancies [33]. This was demonstrated in a recent study examining 6,843 U.S women where an inverse relationship between maternal obesity and breastfeeding was found [34]. In addition, a recent study aimed at evaluating the effects of breastfeeding on maternal weight loss at one-year postpartum found that women who exclusively breastfed for at least three months lost an additional 3.2 lbs. (95% CI: 1.4,4.7) by one-year follow-up [35].

Excessive GWG does not only negatively affect the mother; there is a plethora of research on its long-term effect on the infant. In particular, women with excessive GWG often report the highest mean infant birth weight. High birth weight has been associated with increased odds of weight issues in adolescence by 30-50% [36]). This means that babies born LGA are at increased risk for downstream obesity[18, 36, 37]

A longitudinal study done by Mamun et al. (2013) aimed to examine the link between maternal GWG and childhood obesity [38]. Mamun et. al. used data from a mother–offspring cohort at a 21-year postpartum follow-up. It was reported that children of OW mothers were five times more likely to be OW or OB at 21 years themselves [38]. The intergenerational cycle of obesity further describes this phenomenon, which illustrates that when a mother gains excess

weight when pregnant and gives birth to a LGA baby, there is an increased likelihood of that baby becoming an OW/OB child and an OB/OW adult [37](Figure 1).

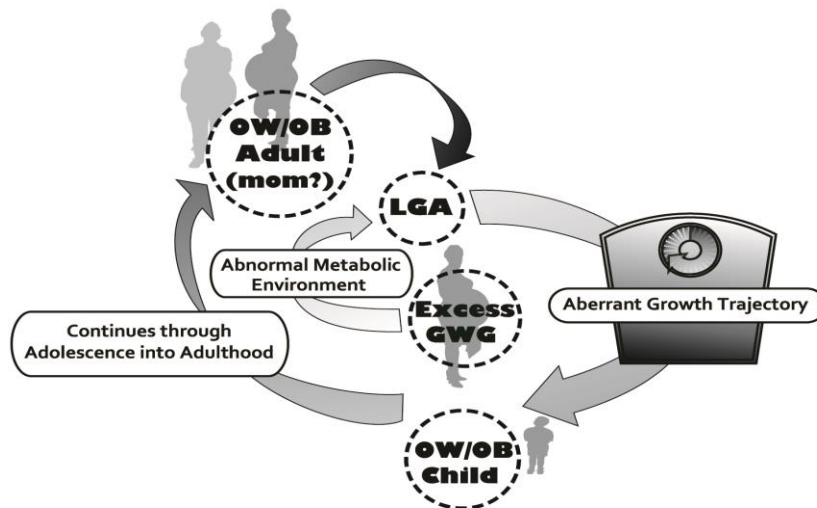


Figure 1: Intergenerational Cycle of Obesity [37]

LGA-large for gestational age, OW/OB-overweight/obese

The latest meta-analyses (published after 2013) clearly demonstrate that excessive GWG during pregnancy and maternal OW/OB can lead to downstream obesity in the child [39, 40]. Nehring et al. analyzed 7 cohort studies that addressed GWG link to childhood obesity specifically [39] and concluded that excessive compared with adequate GWG increases the risk for childhood OW in the range of 21–57% [39]. Mamun et al. reviewed 12 studies and found that offspring of women who gain excessive weight during pregnancy had a 40% (Relative Risk (RR): 1.40; 95% CI: 1.23–1.59) increased risk of obesity compared with offspring of women with adequate GWG [40].

Due to these detrimental short and long-term maternal and child consequences of excessive GWG, numerous interventions have been developed to improve pregnancy outcomes through optimal health and weight gain in pregnant women.

2.4 KNOWLEDGE OF THE GESTATIONAL WEIGHT GAIN GUIDELINES

Women's knowledge of GWG recommendations is an area with limited and contradictory research. To date, studies have shown anywhere between 30 to 70% of pregnant women know how much weight they should gain during pregnancy [41, 42, 42-46]. In a study by Thompson et al. it was reported that 70% of participants (of any BMI) were unable to correctly identify the IOM recommendations for weight gain in pregnancy [43]. In a similar study, Shub et al. it found that women had misconceptions about GWG, especially those who were OW or OB as they were least accurate (65% of OB women overestimated the recommended guidelines for GWG)[42].

Data from a cross-sectional survey conducted by Gaudet et al. assessing 117 Canadian women's knowledge of target GWG amounts and obesity-associated pregnancy complications were consistent with the Thompson [43] and Shub [42] findings with regard to women having limited knowledge about their GWG targets [41]. It was reported that OW and OB women were significantly more likely to overestimate both the minimum GWG (60% and 40%, respectively, $p = 0.02$) and the maximum GWG (85% and 100%, respectively, $p = 0.002$) [41]. It is beneficial to note that Gaudet et al. found no differences between women in the various BMI categories with regard to their awareness of several common obesity-related pregnancy complications[41].

In addition, a recent study of 246 low income, OW/OB women, found that the only unique predictor of correct identification of GWG recommendation range was knowledge and accuracy of pre-pregnancy weight status ($B = .642$, $p = .03$)[47]. The above literature could lead us to

assume that although women know about the risks associated with excessive GWG, they are not accurately classifying their weight or GWG target and, thus, continuing to gain above the IOM recommendations, with OW and OB women being at the highest risk.

As reported by Statistics Canada, the number of OW and OB women has continued to grow in Canada since the updated guidelines were released in 2009 [48]. In addition, recent reports suggest that pregnant women continue to exceed the IOM GWG guidelines, with the highest proportion being women categorized as OW/OB pre-pregnancy, thus contributing to long term weight issues in this population [49]. Further research is needed to determine why women are not aware of the guidelines or benefits of adhering to recommended weight gain amounts while pregnant and if women believe the IOM guidelines to be unattainable or unrealistic. Finally, research is needed to understand if women are able to access the support needed for managing GWG, as this may be beneficial in determining what barriers need to be targeted in future interventions.

2.5 INTERVENTIONS TO REDUCE WEIGHT GAIN IN PREGNANCY

Too few women, regardless of pre-pregnancy BMI, gain weight within recommended ranges and, consequently, interventions aiming to support optimal weight gain in pregnancy are continuing to be developed. It has been proposed that pregnancy is an ideal time for health related interventions as women are in regular contact with health care professionals and are more receptive to change that may positively influence the growth of their baby [47]. It is often suggested that women who exhibit excessive GWG may have unhealthy lifestyles that include low PA levels in combination with a high-energy diet, but the best way to address the growing number of women who are gaining too much weight while pregnant remains largely unanswered.

There have been six meta –analyses and/or systematic reviews published since 2010 that examined studies targeting PA during pregnancy [50-55]. Of the six reviews, four identified a significant impact on GWG (Mean Difference (MD) –0.36 to -0.61). Some focused exclusively on RCTs [50-52] and others examined interventions of any design [53, 54]. Collectively these reviews identify that intervention targeting pregnancy weight management can be effective in reducing excessive GWG.

Most recently a Cochrane review of 24 interventions (n=7,096) (Muktabhant, 2015), using diet, exercise or both, reported success in reducing the risk of excessive GWG by 20% overall [55]. The Muktabhant review supported previous literature that demonstrated the positive effect interventions have on moderating GWG. For example, in a 2013 systematic review and meta-analysis of 11 RCT trials by Choi et al. also reported similar results [52]. The Choi meta-analysis found that women who were provided PA or PA plus diet intervention gained 0.91kg less during pregnancy than the control (p=0.035, 95% CI:-1.76, -0.06). The PA plus diet interventions showed the highest significant reduction of 1.17kg (MD) in GWG (p=0.017, 95% CI: -2.14, -0.21) [52]. In another systematic review by Sui et al. (2012) (n=5 RCT trials) it was found that interventions were associated with a 0.36 kg lower gestational weight gain (p=0.008, 95% CI: –0.64 to –0.09) [56] and, finally, in a meta-analysis by Streuling (2010) (n=12 RCT trials), a reduction of 0.61kg GWG was reported within the intervention groups (p=0.03, 95% CI: -1.17, -0.06) [50].

Contradictory to the reviews summarized above, interventions to reduce GWG do not always report positive, definitive outcomes. A systematic review by Hill et al. (2013) examined 21 published intervention studies aimed at reducing excessive GWG and found no significant difference and could not conclude if interventions to reduce GWG were beneficial. [53]. In

addition to the Hill review, a systematic review performed by Campbell et al (2011) reviewed both qualitative and quantitative behavioural interventions [54]. The authors noted that no clear evidence of either effect or lack of effect to prevent excessive GWG was found.

It is apparent that despite the IOM guidelines being widely available, women continue to gain outside the target amounts. Overall, most current evidence-based meta-analysis and systematic reviews clearly indicate that focused lifestyle interventions during pregnancy can help to reduce excessive GWG and related pregnancy complications. Authors have suggested that interventions should aim to prepare health care professionals to counsel and educate women about healthy weight gain in pregnancy [42, 57].

2.6 EFFECTS OF DIET DURING PREGNANCY

Historically, investigations on the developmental origins of health and disease hypothesis have focused on maternal under-nutrition and specific nutrient deficiencies. Today, the world faces the dual burden of malnutrition that encompasses both under- and over-nutrition [58, 59]. An unhealthy diet during pregnancy has been associated with excessive GWG and issues with post-partum weight retention[52, 60, 61]. Significant predictors of excessive GWG during pregnancy that have been identified include; dietary behaviours related to intake [21, 54], composition, diet patterns (high fat, sugar, and carbohydrate (CHO) intake) [62] and lack of PA [63]. Pregnancy dietary intake has commonly been the focus of observational and intervention studies aiming to identify contributors to high GWG and to reduce the likelihood of exceeding the IOM guidelines [18, 64].

In 2011 Tanentsapf et al. reviewed 13 RCT studies to determine the effect of dietary interventions aimed at reducing GWG in pregnant women (of any BMI) [65]. The review concluded that diet focused interventions during pregnancy were effective in reducing GWG by

1.92kg (n=1434) [65]. However, it was noted that most reviews failed to include the impact that different intervention components, delivery methods or dietary counseling approaches had on gestational weight management. Therefore, it remains unclear as to which intervention components optimize GWG in women.

In contrast to Tanentsapf et al. findings, a study by Shin et al. that assessed diet quality during pregnancy in 490 pregnant women in a cross-sectional study was not included in the Tanentsapf review. Shin found that although diet during pregnancy was not a key determinant of optimal GWG, inadequate intake of total vegetables (OR 3.8, CI 1.1-13.2, p=0.03) and oils (OR 2.8, CI 1.2-6.4, p=0.02) were associated with excessive GWG after controlling for covariates [66]. We may interpret this to mean that a low fat, high fibre (i.e., vegetables) intake is beneficial for optimizing weight management in pregnancy. This study, however, assessed GWG based on a measure made at any time point during the last month of pregnancy. Using a woman's weight at the beginning of her eighth month compared to at birth can impact the final GWG as weight gain can vary greatly in the last month and therefore this measurement method reduced reliability and is a cause of concern.

In the context of over-nutrition effects on the mother, recent evidence supports the belief that excess energy intake can increase predisposition to offspring metabolic disease[64, 67] and alter the ability to deliver nutrients through the placenta, which is another factor that determine optimal health nutrient availability for the fetus. Godfrey and colleagues (1996) looked at placental weight and maternal nutrition and suggested that a low placental weight can indicate that there is a depleted amount of nutrients transferred to the fetus, which results in impaired fetal growth [68]. In addition, as reported in two separate reviews and meta-analysis by Thangaratinam (2012), maternal diet, specifically in terms of high total energy intake is a risk

factor for LGA infant and excessive GWG [24, 69]. A review by Ota (2012) showed that both a high CHO intake ($> 340\text{g/day}$) early in pregnancy and a low intake of dairy and meat protein ($< 76\text{ g/day}$) late in pregnancy are associated with lower placental weight as well as a LGA infant[70]. Finally, high sugar consumption in pregnancy has recently been looked at by Whisner et al. in a pregnant adolescent cohort [71]. Specifically, the Whisner study found that high sugar intake by the mother was associated with increased accumulation of fetal abdominal fat with little net effect on birth weight. This finding can lead us to attribute increased sugar intake during pregnancy to shifts in fetal body composition [71].

Given the increased prevalence of high pre-pregnancy BMI and the intergenerational nature of this condition [37], attention has shifted to threats of over-nutrition during pregnancy as an important contributor to maternal long-term obesity and infant metabolic deregulation later in life [37]. It is difficult to determine the ideal diet for pregnancy, since all women enter pregnancy with differing nutrient stores and body compositions. However, dietary recommendations have been developed for normal pre-pregnancy BMI women and there is a consensus that in order to achieve appropriate maternal and fetal growth, nutritional guidelines should be followed, and diet should be composed of high quality, nutrient-dense foods [55, 63, 68, 72].

2.7 DIETARY REQUIREMENTS IN PREGNANCY

There is an abundance of data from human cohort and observational studies as well as animal studies indicating that the macronutrient intake from maternal diet is critical for optimal development of the fetus[60, 73-75]. Changes in metabolism that occur during pregnancy result in more efficient use and absorption of nutrients; therefore, the need for an increase in energy intake is minimal.

Despite the described relationship between high GWG, poor diet and adverse outcomes for women and infants, a systematic review done by Alavi et.al. (2013) found that there are currently a wide variety of recommendations from various countries regarding the changes in dietary requirements during pregnancy[76]. The recommendations range from an additional 0 to 350 kcal/d for the first trimester, 0 to 358 kcal/d for the second trimester and finally from 200 to 573 kcal/d for the third trimester[76].

It is important to clarify that although there is an increased requirement in caloric intake during the second and third trimester of pregnancy, the quality of nutrition is equally relevant. While there is an increased requirement of certain vitamins (i.e., A, C, D) and micronutrients (thiamin, riboflavin, folate), the common saying ‘eating for two’ is no longer accepted or promoted [49]. A balanced maternal diet that is high in fibre (fruits and vegetables), contains moderate protein (plant/ animal sources) and avoids energy-dense, nutrient poor foods (sugar sweetened beverages and saturated fats), similar to a typical balanced, healthy diet, is beneficial for both the mother and fetus [77].

The IOM recommendations for energy requirements during pregnancy (outlined in The Dietary Reference Intakes (DRI)/Recommended Daily Allowance (RDA)/ IOM values) [77] are supported by Health Canada and used by Canadian health care professionals nation-wide. The recommendations suggest no additional calories are needed during the first trimester with increases of 340 kcal/d in the second trimester and 450 kcal/d in the third trimester (Table 3). The target intakes are based on the energy needs of women who are considered of a healthy weight. Unfortunately the actual energy requirements for pregnant women who are OW and OB, underweight or have high levels of PA are presently unknown.

Nutrients	Canadian Daily Dietary Reference Value (DRI) Grams/day (% total energy)
Energy (kcal)	
1st trimester	+ No additional calories
2nd trimester	+ 340 kcal/day
3rd trimester	+ 450 kcal/day
Total Fat ¹	20-35% Energy
Saturated Fat	Minimize
Carbohydrate	175 g/day (45-65%)
Protein	71 g/day (10-35%)
Fibre 2	28 g/day (AI)

Table 3: Canadian Dietary Intake Recommendations

Adapted from Blumfield, 2012 [78]. AI=adequate intake

1Total fat intake recommendations are only in percent total intake/ day for pregnancy

2 Fibre intake recommendations are only in grams/day total intake

Studies have shown that energy dense diets (high kcal/g) may promote overeating as energy dense foods have shown to be less satisfying per gram of food consumed[62, 79]. Therefore, it is possible that women who consume high energy foods may overeat, gain weight and exceed the IOM GWG guidelines. It is important to consider that diet is only one side of the energy in/ energy out equation. In addition to the effects of diet in terms of energy intake on weight gain, PA is another modifiable lifestyle factor that can contribute to managing weight gain during pregnancy and should be addressed.

2.8 EFFECTS OF PHYSICAL ACTIVITY DURING PREGNANCY

Monitoring fetal growth, maternal weight, nutritional intake and exercise duration and intensity is necessary throughout pregnancy [18]. There are multiple studies that provide evidence to demonstrate that PA during pregnancy is beneficial and safe [80]. Regular prenatal exercise is an important component of a healthy pregnancy as PA is associated with multiple benefits for both mom and baby [18, 50, 54, 63, 80-82]. The exact quantity, quality, frequency,

and duration of PA needed to achieve a certain health outcome during pregnancy have yet to be determined. In fact, a Canadian group is working towards developing evidence-based guidelines for this population (Mottola, Davenport, Ruchat, Davies, and Adamo).

There are, however, older, less evidence based recommendations published and endorsed by the Society of Obstetricians and Gynecologists of Canada / Canadian Society for Exercise Physiology (SOGC/CSEP) and the American College of Obstetricians and Gynecologists (ACOG) for use during pregnancy [83-85]. The current Canadian Physical Activity Guidelines (CPAG) suggest that accumulating 150 minutes/wk. of moderate-to-vigorous PA in 10-minute bouts may be appropriate for pregnant women[86].

Although there are no commonly agreed upon recommendations for PA intervention during pregnancy, there is a consensus that it is beneficial to educate women on eating a healthy diet in combination with PA. It has been found that with appropriate knowledge, women are more likely to gain the recommended amount of weight throughout pregnancy[87, 88]. Although PA is an important contributing factor for appropriate GWG, it has been documented in large epidemiological studies that used self-report data that approximately 60% of women are not meeting PA recommendations while pregnant [89].

In an RCT study by Sui et al. (2013), 305 OW or OB women completed a PA questionnaire at three-time points throughout pregnancy (early pregnancy, 28 and 36 weeks gestation) and once in post-partum (4 months post-partum) [51]. Sui et al. concluded that PA during pregnancy in OW/OB women significantly declines throughout pregnancy (between early pregnancy and 28-weeks gestation ($P < 0.001$) and declined further at 36-weeks gestation ($P < 0.001$)) before increasing at 4 months post-partum ($P < 0.001$). It was also reported that although PA increases after birth, it was not to the level of that reported at early pregnancy[51].

Systematic review evidence indicated that fear of harming self or unborn baby, physical discomfort, lack of encouragement to exercise from their social support networks, and positive view of overeating were all factors contributing to general decline in PA and excessive GWG during pregnancy[54]. The studies reviewed have suggested further research is needed in the promotion of appropriate physical activity in early pregnancy and postpartum to prevent the decline observed in all women. Understanding women's perceptions of exercising while pregnant, as well as their behaviours, and barriers to engaging in exercise is pertinent to inform future successful PA and health intervention for pregnancy [51].

2.9 KNOWLEDGE GAPS AND FUTURE RESEARCH

Since greater than half of Canadian women of childbearing age are considered OW or OB, and most women are exceeding GWG recommendations, regardless of pre-gravid BMI, both maternal BMI and GWG are key issues that can have significant consequences for population health, obstetric services, and the resources required for the continuation of current standard obstetric care in Canada. This literature review identified that there are few studies of the Canadian population that report on women's knowledge of the risks of obesity in pregnancy, or knowledge of the IOM weight gain guidelines [90, 91]. There is also little research on the barriers women face to gaining within the current IOM GWG guidelines, which is imperative to guide future research and intervention studies.

While there is systematic review evidence to suggest that interventions can limit GWG, there still remains inconsistency in this literature. Some studies have shown that even when women are provided with additional resources to limit GWG, many still gain above the suggested IOM guidelines. Furthermore, results have suggested that OW and OB women are

more likely to overestimate appropriate weight gain for pregnancy and to misinterpret their body size [22, 28, 51, 87].

Suggested steps for future studies to improve women's knowledge or perceptions on the 2009 IOM recommendations include, education regarding appropriate gestational weight gain, development of a tool to guide women about GWG [44] and further research and test interventions to improve counseling about GWG. These are all logical initial steps for optimizing weight-related pregnancy outcomes.

Studies are especially limited in Canadian women and their perceptions of GWG, knowledge of dietary intake during pregnancy and how best to provide assistance to overcome the barriers women face in reaching health goals during pregnancy. This being said, further research is essential to gain insight into women's knowledge and perceptions of the dietary guidelines within pregnancy and also of weight gain guidelines based on current IOM recommendations.

Chapter 3

DIETARY INTAKE RESULTS FROM THE MATERNAL OBESITY MANAGEMENT INTERVENTION TRIAL

Over the last number of years, our group has been performing a pregnancy focused lifestyle intervention, the Maternal Obesity Management (MOM) Trial, which included both a dietary and physical activity component. As originally proposed, we wanted to examine the uptake and adherence to dietary advice provided during the MOM trial; thus, this chapter describes a comparison of the dietary data in intervention and control participants. Specifically, it describes the comparison of macronutrient intakes and assessment of diet quality in intervention and control groups. The MOM trial was a randomized controlled trial (RCT) lifestyle intervention that targeted pregnant women in Ottawa, Ontario[92]. A total of 76 women were recruited and randomized to a structured PA and nutrition intervention program (n=41) or a usual care control group (n=35). An intention-to-treat analysis was performed, in which all patients randomly assigned to one of the arms were analyzed together regardless of whether or not they completed or adhered to the intervention. Basal Metabolic Rate (BMR), used as a baseline energy expenditure requirement (at rest), was measured for all intervention women (measured with indirect calorimetry using a metabolic cart) and calculated for all control women (using the Pennington Biomedical Research Center RMR online calculator [93]). Previous literature has demonstrated that the BMR calculation is relatively accurate and comparable to a measured BMR using the metabolic cart [94]. PA was measured through the use of an *Actial accelerometer* (women wore for 7 days at each time point).

3.1 DIETARY INTERVENTION COMPONENT METHODS

All subjects met with a dietitian at two time points during the trial; immediately after recruitment and at the beginning of their third trimester. At the initial appointment, the dietitian discussed weight and diet history, fast food consumption and suggested changes to current eating habits as recommended by Health Canada's nutritional guidelines for pregnancy [77]. The second personalized dietitian counseling session discussed previous dietary records, suggested possible beneficial changes or considerations and reiterated the goals of the first session. Intervention participants were required to attend additional group nutrition education classes (three sessions), and received trimester-specific nutritional and/or PA post-cards (every four weeks during the intervention) (see protocol for further information on intervention components [92]). The control group received standard clinical care as recommended by the Society of Obstetricians and Gynecologists of Canada (SOGC) [95]. Subject in both groups were asked to keep a 7-day food record at three points during pregnancy (intervention period) (baseline (visit 1 (V1): 12-20 weeks), between 26-28 weeks (visit 2 (V2)) and between, 36-40 weeks (visit 3 (V3))).

3.2 DIETARY ANALYSIS HYPOTHESIS

We hypothesized that women who were in the intervention group and received additional advice about healthy pregnancy practices would report better overall quality diets (dietary intakes within Health Canada recommendations) and that intervention women would be more physically active.

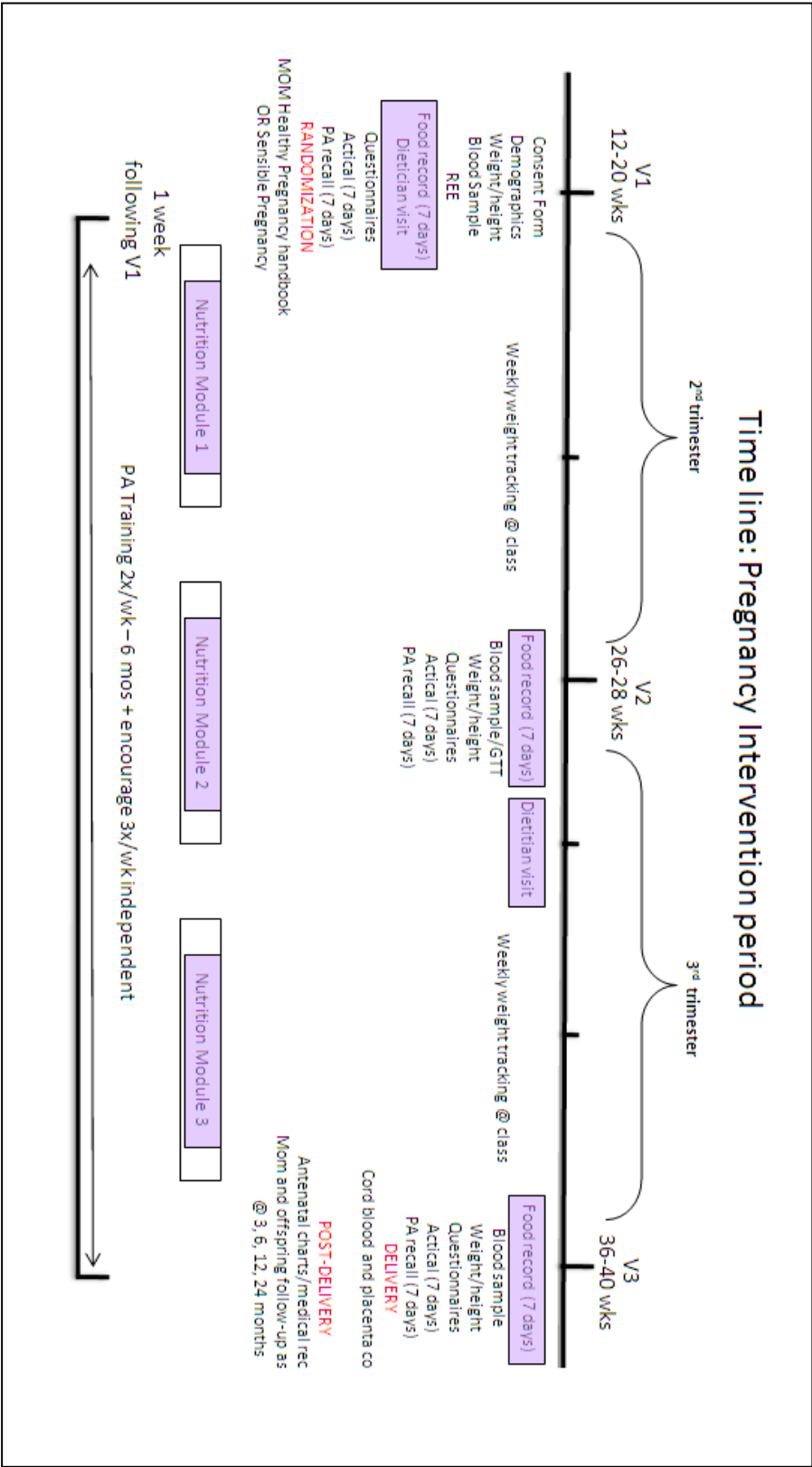


Figure 2: MOM Trial timeline highlighting all dietary components

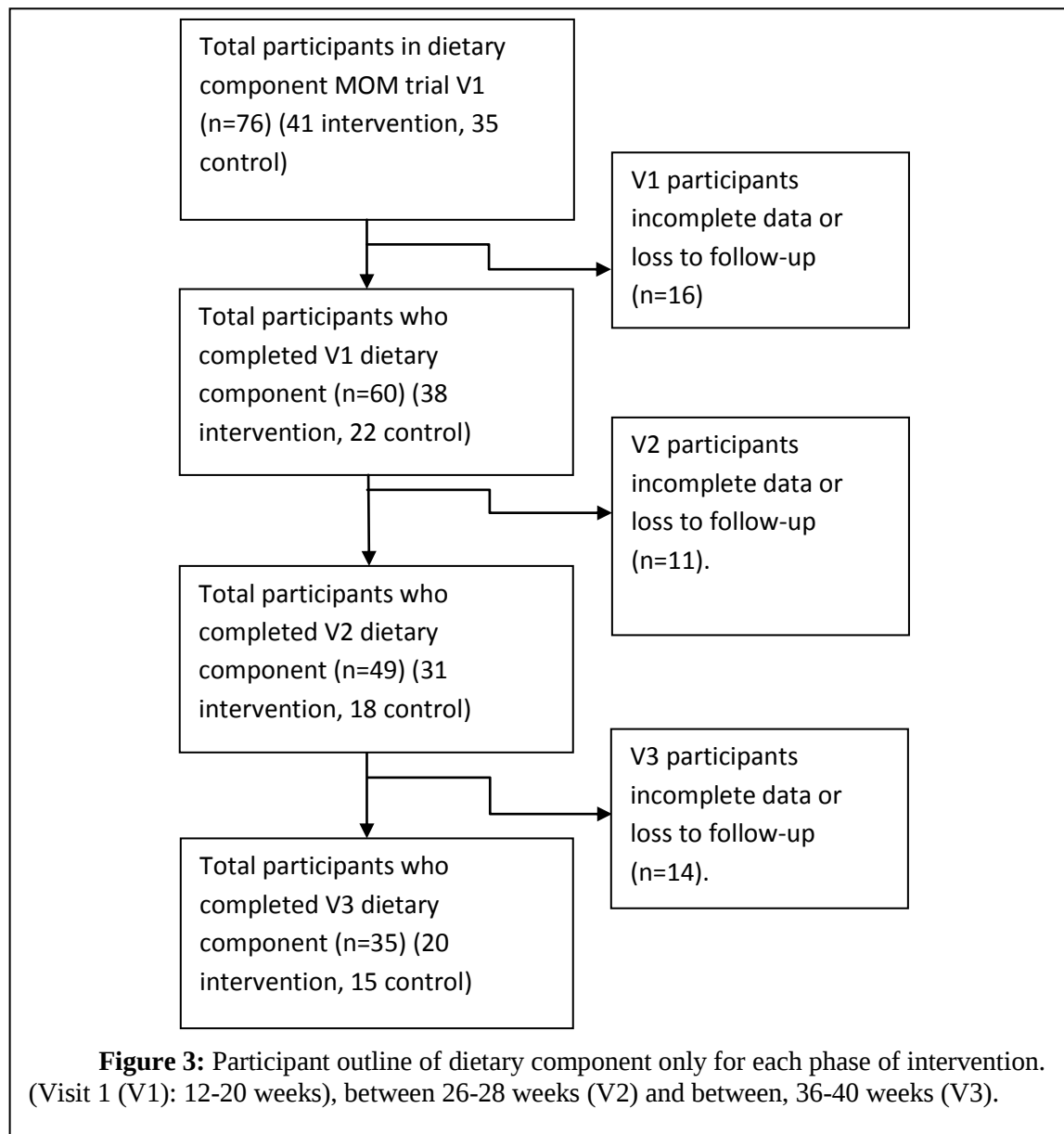
3.3 ANALYSIS RESULTS

Of the 76 women randomized (n=41 intervention, n=35 control), a total of 60 women completed V1 food records (n=38 intervention, n=22 control), 49 completed V2 (n=31 intervention, n=18 control) and 28 completed V3 (n=20 intervention and n=15 control). All exclusions account for loss to follow-up or incomplete data (food records with less than four completed days). Descriptive statistics for the 38 intervention and 22 control participants are presented in Table 4. The majority of the women were 28-34 years, Caucasian, married, university educated, and from high-income households. There were no significant differences between intervention and control regarding pre-pregnancy BMI and total GWG distribution.

Intention- to- treat (ITT) analysis was conducted and the dietary intakes are reported in Table 5. The DRI recommendations for fat are only available in percent total daily intake for pregnant women, and therefore, intake is reported in percent/day for fat as well as absolute value (grams/day). Fat and saturated fat was significantly lower at baseline (V1) in the intervention group with reported fat intakes of 76.6g compared to 87.2g and saturated fat intakes of 25.2g compared to 28.2g in the intervention and control groups, respectively. Within group changes in the control group include a significant decrease in fat and energy intake at V2, with a subsequent increase in fat intake at V3 and a continuous decline in saturated fat intake across pregnancy (V1-V3). No significant changes in the intervention group were found.

A comparison between groups BMR and actual energy intake as well as PA is outlined in Figure 4 and Figure 5. BMR and PA data is shown in Figure 6. No difference was found in the BMR data for either group, which would be expected as women had no BMI differences and thus, we presume had similar body composition. Moderate- to - vigorous PA in the intervention group was 21.5 min/day and 19.75 min/ day for V1 and V2, respectively and reduces significantly for V3 at 4.0 min/day, compared to 11.95, 11.0 and 14.2 min/day at V1, V2, V3

respectively in the control group. In addition to assessing dietary relationships within and between study groups, effect size (ES) was calculated to assess these relationships more fully (Table 6). Moderate (0.51-0.80) and large (>0.80) values are highlighted and include a significant change in control group fat intake from V1-V2 (-0.56) and between group differences for fat, saturated fat and energy in V1 (-0.84, -0.72, -0.56 respectively).



3.4 DISCUSSION

Although the intervention group reported a lower total fat and saturated fat intake at baseline, no improvements in dietary quality were found throughout pregnancy. The control group experienced a significant decrease in fat and energy intake at V2, with a subsequent increase in fat intake at V3 and a continuous decline in saturated fat intake across pregnancy (V1-V3). There were no notable dietary differences between intervention and control groups, and no significant difference in GWG.

All women, regardless of group, met the recommendations for total energy intake from fat, with lowest values seen in the intervention group for all time points. However, participants reported high carbohydrate (CHO), protein (PRO) and sugar intakes, all well over the recommendations. The intakes ranged from 262.0g-286.5g for CHO (compared to recommended 175g/day), 80.1g-88.8g for PRO (vs. 71 g/day target) and 99.0g-106.2g for sugar (vs. 25-50g/day target). Fibre intake was under the recommended amount in both groups with ranges from 23.5g to as low as 21.5g (instead of 28g/day).

Although not significant, women in the intervention group reported higher energy intakes than expected based on their BMR (Figure 4), which compliments their higher PA levels (Figure 5), although not statistically significant. Interestingly, women in the intervention group reduced their MVPA at V3.

We believe that the minimal differences between intervention and control participants reported diet quality and total GWG can be attributed to poor adherence to the dietary advice/guidance and a distinct lack of adherence to PA components (0% by V3 of participants meeting all PA protocol requirements) for those in the intervention group. The Hawthorne effect is also a possibility whereby participants modified their behaviour as a result of being enrolled and assessed for diet intake [96]. We are also aware that women who agreed to be randomized to

this intervention were already interested in health behaviours and thus were more likely to engage in a healthy lifestyle during the intervention (improved diet and increased exercise).

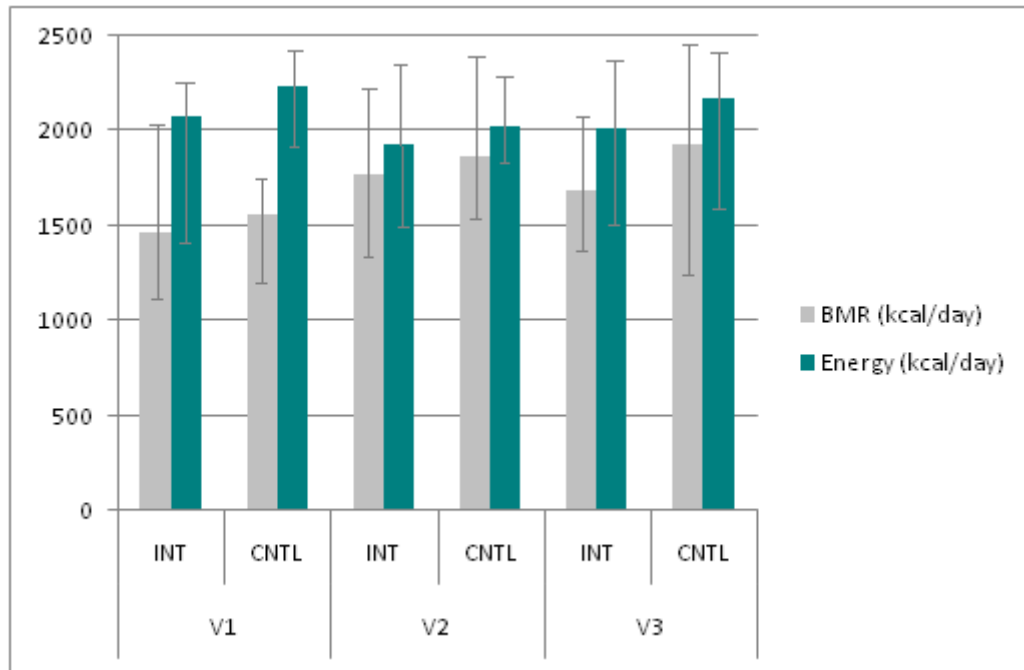


Figure 4: BMR and actual energy intake of Intervention and Control women

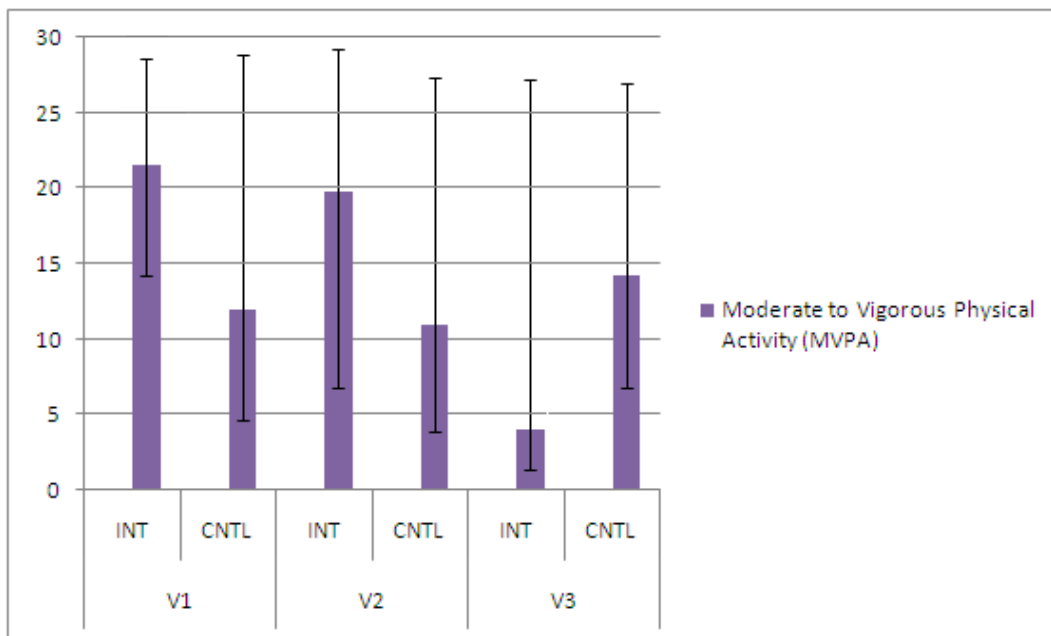


Figure 5: Minutes of MVPA per day in Intervention and Control women

Limitations of this study include the use of self-reported dietary intake; self-reported data may be exaggerated or under-reported and various biases may affect the information (social desirability bias or Hawthorne effect)[26, 97]. This study used 7-day dietary records to reduce the issues with self-report, as this method was known as the gold-standard for dietary data collection at the time [98]. While we completed rigorous data auditing to reduce data entry error, this remains a potential limitation.

3.5 CONCLUSION

In comparison to the control group, there were no notable dietary intake improvements in the intervention group. Women were given the opportunity to attend PA and dietary classes but were not as receptive/ adherent to interventions as we had hoped. Research is warranted to further develop interventions that allow for minimal effort from participants to reduce dropout and improve compliance in order to optimize outcomes. Compliance was extremely low for intervention participants in this trial, which is the factor to which we attribute the lack of difference between groups.

Table 4: Descriptive statistics (comparing Intervention and Control) (N=60)

Descriptive	Intervention χ(SD) (n=38)	Control χ(SD) (n=22)	Mann-Whitney U test
Age (yrs.)			P= 0.81
	32.67 (4.21)	32.94 (4.47)	
GWG (kg)			P=0.44
	14.77 (4.40)	14.55 (5.66)	
Descriptive	Intervention N (%)	Control N (%)	Pearson Chi Sq
Pre-pregnancy BMI			P=0.28
Normal (18.5-24.9)	7 (18.4%)	5 (22.7%)	
Overweight (25.0-29.9)	15(29.5%)	10 (45.5%)	
Obese (>30.0)	16 (42.1%)	7 (31.8%)	
Ethnic group			P= 0.60
White	27 (71.1%)	17 (77.3%)	
All other ethnicities	11 (28.9%)	5 (22.7 %)	
Marital status			P= 0.23
Married	30 (78.9%)	20 (90.9%)	
Other marital status	8 (21.1%)	2 (9.1%)	
Education			P=0.88
University	30 (78.9%)	17 (77.3%)	
Less than University	8 (21.1%)	5 (22.7%)	
Occupation			P= 0.60
Employed	33 (86.8%)	18 (81.8%)	
Other employment status	5 (13.2%)	4 (18.2%)	
Residence			P= 0.47
House	30 (78.9%)	19 (86.4%)	
Other residence	8 (21.1%)	3 (13.6%)	
Income			P= 0.41
< \$100,000/ yr.	16 (42.1%)	7 (31.8%)	
>= \$100,000/ yr.	22 (57.9%)	15 (68.2%)	

Table 5: Dietary intakes at visit 1 (V1), visit 2 (V2) and visit 3 (V3) in intervention and control group

	Intervention (n=38)			Control (n=22)		
Variable	V1	V2	V3	V1	V2	V3
Energy (kcal/day)	2080.33 (1106.6-2875.5)	1932.12 (1426.0-3468.6)	2019.41 (1151.1-3252.9)	2240.34 (1545.1-3214.4)	2024.27 (1504.3-3095.8) α	2172.86 (1584.9-3095.9)
Fat (g)	76.58 (30.5-104.0)*	68.89 (31.2-143.2)	74.23 (31.72-136.81)	87.17 (59.5-118.2)	76.54 (46.5-104.3) α	81.94 (51.6-97.1) b
Fat (% energy)	31.6 (23.2-40.5)	30.9 (16.3-37.2)	31.75 (23.2-41.3)	33.65 (26.1-43.3)	30.85 (24.8-50.5)	32.0 (23.0-44.0) b
Sat. Fat(g)	25.19 (10.8-36.2)*	22.73 (8.8-59.2)	25.79 (11.32-50.56)	28.21 (18.1-46.2)	26.04 (13.7-39.8)	25.01 (15.8-36.1) α
CHO(g)	262.00 (127.5-378.7)	269.05(175.9-449.8)	267.38 (127.48-413.09)	285.03(160.6-463.2)	270.44 (121.8-463.2)	286.50 (191.5 - 468.5)
PRO(g)	80.11 (45.0-141.0)	83.21(50.2-144.1)	81.14 (56.13-138.45)	88.8 (61.4-123.8)	82.43 (61.4-134.5)	84.30 (61.3-123.8)
Fibre(g)	23.21 (9.5-58.6)	24.22 (15.2-43.8)	22.89 (11.04-41.51)	22.99 (14.9-37.7)	21.55 (13.1-37.9)	23.53 (14.0-37.9)
Sugar(g)	99.42 (29.6-169.6)	99.02 (59.7-195.7)	97.90 (1.11-187.79)	106.19 (46.6-203.4)	96.68 (54.9-224.2)	91.85 (59.3-213.8)

* Difference between groups for same moment (p<0.05)

α - difference from V1 (p<0.05)

B - difference from V2 (p<0.05)

CHO =carbohydrate, PRO =protein.

Sat. Fat = saturated fat, CHO =carbohydrate, PRO =protein.

Table 6: Effect Size for Intervention (between visits), Control (between visits) and Intervention vs. Control at same visit

	Intervention			Control			Intervention vs. Control		
Variable	V1xV2	V2xV3	V1xV3	V1xV2	V2xV3	V1xV3	V1	V2	V3
Energy	0.05	-0.02	0.02	-0.39 α	0.23	-0.18	-0.56	-0.13	-0.38
Fat	-0.03	0.11	0.09	-0.56α	0.46 α	-0.49 b	-0.84*	-0.36	-0.36
Fat %	-0.22	0.23	0.04	-0.58	0.22	-0.47 b	0.57	-0.01	0.06
Sat. Fat	-0.01	-0.15	-0.05	-0.43	0.17	-0.51α	-0.72*	0.31	-0.04
CHO	0.10	-0.12	-0.02	-0.15	0.16	0.01	-0.32	-0.09	-0.36
PRO	0.09	-0.09	0.00	-0.24	-0.03	-0.26	-0.28	0.06	-0.01
Fibre	-0.01	-0.15	-0.05	-0.43	0.17	-0.51α	-0.72*	0.31	-0.04
Sugar	0.09	0.07	0.07	-0.19	-0.06	-0.54	0.01	-0.36	-0.18
Energy	0.27	-0.17	0.05	-0.03	-0.01	-0.04	-0.20	0.04	-0.12

All $\geq$ moderate effect sizes are highlighted (moderate: 0.51-0.80; large: >0.80)

* Shown difference between groups for same moment ($p < 0.05$)

α - shown difference from V1 ($p < 0.05$)

b – shown difference from V2 ($p < 0.05$)

Chapter 4

PREAMBLE TO MANUSCRIPT ONE

In order to further assess the dietary data from MOM trial, as the intervention was unsuccessful due to a lack of adherence and compliance to the PA and dietary components, a secondary exploratory, pooled-analysis was completed to examine the potential contribution of diet to meeting weight gain targets. The findings from this analysis are outlined in *Manuscript 1 “Dietary Analysis of Excessive and Non-Excessive Weight Gain in Participants from the Maternal Obesity Management (MOM) Trial”*.

It is well known that diet contributes to weight management in the general population. We wanted to identify if diet played a role in meeting GWG guidelines in the participants in the MOM trial. In the following manuscript, we categorized women based on either meeting or exceeding their IOM GWG target weight, regardless of randomization.

Chapter 5

MANUSCRIPT 1: DIETARY ANALYSIS OF EXCESSIVE AND NON- EXCESSIVE WEIGHT GAIN IN PARTICIPANTS FROM THE MATERNAL OBESITY MANAGEMENT (MOM) TRIAL

Dietary Analysis of Excessive and Non-Excessive Weight Gain in Participants from the Maternal Obesity Management (MOM) Trial

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5.1 ABSTRACT

Background: Less than 40% of women gain the recommended amount of weight during pregnancy. This is concerning, as gaining weight above the gestational weight gain (GWG) guidelines has been associated with increased risk of pregnancy-related complications, postpartum weight retention, and long-term obesity. Current research on the ideal distribution of macronutrients for weight management during pregnancy is inconclusive and studies are needed to identify dietary risk factors for excessive GWG. **Methods:** The primary objective of this paper was to conduct a pooled analysis of dietary data from Maternal Obesity Management (MOM) trial participants to identify diet quality of women who exceeded (EX) versus did not exceed (NEX) the 2009 Institute of Medicine (IOM) pregnancy weight gain targets. A total of 35 participants were included in this dietary analysis (n=22 EX and n=13 NEX). Nutrient intake and group-by-time interactions were tested using ANCOVA (adjusted for measured moderate to vigorous physical activity levels). Participants completed 7-day food records and wore an actical accelerometer at 3 points during pregnancy, including at baseline (V1: 12-20 weeks), between 26-28 weeks (V2) and between, 36-40 weeks (V3). **Results:** Significant decreases in total energy intake, including fat, and protein were found across pregnancy in the NEX GWG group. Significant interactions were found for energy intake and protein intake. **Conclusions:** Our data indicate a potential role of energy intake (specifically fat and CHO) in optimizing weight gain in pregnancy. More comprehensive research is warranted on macronutrient intake in pregnancy including the role of fat and CHO on gestational weight management.

Keywords: pregnancy, Maternal Health; Gestational Weight Gain; Institute of Medicine Guidelines; Maternal Diet; macronutrients

5.2 INTRODUCTION

It is well known that obesity is a global epidemic [99]. With this increase in prevalence of obesity, the percentage of overweight (OW) or obese (OB) pregnant women presenting for obstetric care continues to grow [100]. High pre-pregnancy Body Mass Index (BMI) (>25 BMI), alone or in combination with excess gestational weight gain (GWG) has been shown to increase the risk of poor pregnancy outcomes, including gestational diabetes mellitus (GDM), preeclampsia, and cesarean section [20]. The Institute of Medicine (IOM) developed evidence-based GWG recommendations, based on pre-pregnancy BMI cut-points, that reflect the need to mitigate pregnancy-related complications [2]. The weight gain recommendations include specific targets for women considered underweight, normal weight, OW and OB and the recommended range decreases as BMI increases [2]. Unfortunately, over 60% of women gain in excess of these guidelines while pregnant, further exacerbating health issues related to obesity in women [10, 11].

Dietary intake and physical activity (PA) have commonly been the focus of observational and intervention studies aiming to identify contributors to, or factors attenuating excessive GWG [2, 64]. A recent Cochrane review of 24 interventions (n=7,096), performed by Muktabhant et al., found that diet, exercise or both reduced the risk of excessive GWG by 20% overall [55]. What this and other reviews have been unable to do is pin-point which specific aspects of one's diet impact GWG.

There is an abundance of data that indicate that high quality diet is critical for optimal health of the mother and development of the fetus [62, 101]. However, studies have reported inconclusive results and controversy exists about the most beneficial dietary composition relating to optimal GWG, especially for those with a high pre-pregnancy BMI [14–17]. Changes in metabolism that occur during pregnancy result in more efficient use and absorption of nutrients

[17]; therefore, despite perceptions on the contrary, the need for an increase in energy intake is minimal. The significant predictors of high pregnancy weight gain that have been identified include, dietary behaviours related to intake [21, 54], composition [102], diet patterns (fat, sugar, and carbohydrate (CHO) intake) [62] and lack of PA [63].

The IOM dietary recommendations, supported by Health Canada, for dietary requirements during pregnancy (outlined in the Dietary Reference Intakes (DRI)/Recommended Daily Allowance (RDA)/ IOM values)[77] suggest one's diet should be composed of high quality, nutrient-dense foods in order to achieve optimal maternal and fetal growth during pregnancy [2, 77]. The recommendations outline that no additional calories (kcal/day) are needed during the first trimester with increases of 340 kcal and 450 kcal in the second and third trimesters respectively. These recommendations are based on the energy needs of women who are considered of a healthy weight (BMI 18.5-25.0) and include a breakdown for each macronutrient (protein, fat, carbohydrate, fiber). Unfortunately the actual energy requirements for pregnant women who are considered underweight, OW, OB, or have high levels of physical activity are presently unknown.

Macronutrients	Canadian Daily Dietary Reference Value (DRI) grams/day (% total energy)
Energy (kcal)	
1st trimester	+ No additional calories
2nd trimester	+ 340 kcal/day
3rd trimester	+ 450 kcal/day
Total Fat ¹	20-35% Energy
Saturated Fat	Minimize
Carbohydrate	175 g/day (45-65%)
Protein	71 g/day (10-35%)
Fibre ²	28 g/day (AI)

Table 7: Canadian Dietary Intake Recommendations for Pregnant Women

Adapted from Blumfield, 2012 [78]. AI=adequate intake

1Total fat intake recommendations are only in percent total intake/ day for pregnancy

2 Fibre intake recommendations are only in grams/day total intake

In addition to the importance of macronutrient intake, sugar intake specifically has recently been targeted as a contributor of excessive weight gain in the general population [103, 104]. In response to this, the World Health Organization (WHO) recently released a report outlining the negative impact of high sugar consumption and included sugar intake recommendations of 5-10% total energy/day (25-50g) to address this growing concern [105].

In this study we sought to compare changes in dietary composition across pregnancy in women engaged in a lifestyle intervention trial targeting excessive GWG. Preliminary analyses of the trial identified that adherence to the intervention was low and subsequently unsuccessful in impacting GWG, thus a secondary objective was to compare dietary intake (macronutrients and more detailed components of each e.g., sugar, fibre) across pregnancy in participants who exceeded compared to those who did not exceed GWG targets. We hypothesized that women who were in the NEX group would report better overall quality diets (dietary intakes within Health Canada recommendations).

5.3 METHODS

The MOM trial was a lifestyle intervention targeting pregnant women in Ottawa, Ontario[92]. Primary outcomes related to maternal and child weight trajectories have been submitted for publication elsewhere (*APNM, in preparation*). The present study represents a secondary data analyses focused specifically on dietary intake. This study was approved by the Research Ethics Board (REB) of the Children's Hospital of Eastern Ontario (CHEO) (CHEOREB#09/03E).

Women completed 7-day food diaries at three time points during pregnancy. The food diaries were analyzed using the Food processor program (ESHA) (version 13.0). An average Dietary Reference Intake (DRI) value of the seven days reported in the diet record was used for

each macronutrient (fat, carbohydrate (CHO), protein (PRO), fibre) and sugar. Dietary data collected from all participants, regardless of intervention or control group, were analyzed to determine if diet improvements were evident across pregnancy.

The exploratory, pooled analysis categorized participants as either excess (EX, n=22), weight gain above the 2009 IOM guidelines, or non-excess (NEX, n=13), weight gain under or meeting IOM guidelines (n=2 under and n=11 met). GWG was calculated by subtracting weight at the initial prenatal visit in the first trimester (baseline, V1) from weight at the last trial assessment (V3) or prenatal visit before delivery (whichever occurred last). Total dietary composition was assessed in EX and NEX groups using the food records and dietary intake was compared to the national dietary recommendations to establish diet quality.

5.4 SUBJECTS

Women with a BMI: ≥ 18.5 kg/m² and < 40 kg/m² who were 18 years or older at time of recruitment, who planned to give birth locally, and were pregnant with a singleton fetus were eligible. Only women given medical clearance by their health care provider were consented to participate. Women were excluded if they reported being a smoker, having a medical condition that could impact body weight, or reported an inability to exercise.

5.5 STATISTICAL ANALYSES

All data analyses were performed using SPSS (version 13.0). Analysis of daily nutrient intake was performed using 7-day food records from baseline (V1: 12-20 weeks), between 26-28 weeks (V2), Data normality was tested through Shapiro-Wilk test. We compared baseline characteristics between the EX and NEX groups, examining the differences in demographics (and pre-pregnancy BMI distribution).

Categorical variables are presented as numbers (percentages) and continuous variables were tested using the Mann–Whitney U test and are presented as means $\pm$ SD or median (interquartile range). Group differences in primary and secondary outcomes are illustrated as estimated marginal mean differences or odds ratios with 95% CIs.

In the comparison of EX and NEX groups, we adjusted for moderate to vigorous PA (average min/day, recorded via actical). We tested group effects on energy intake using repeated measurements analysis of covariance (ANCOVA) adjusted by physical activity as measured MVPA (average min/day). Differences in dietary intake between each group using the Friedman or Wilcoxon test was analyzed and a two-sided statistical evaluation was performed at a 0.05 level of significance. We analyzed dietary endpoints in an explorative manner, and resulting p-values were corrected for multiple testing using Bonferroni post-hoc.

As a complementary analysis we used the effect size (ES) ($ES = [\text{mean posttest} - \text{pretest mean}] / \text{pooled SD}$) to determine the magnitude of the effect of dietary intake across assessment visits both within groups and between EX and NEX women. The effect size was classified according to Cohen (1988) [106] as being trivial: ≤ 0.20 ; small: 0.21-0.50; moderate: 0.51-0.80; large: >0.80 . P-values less than 0.05 are considered significant for all analysis in this study.

5.6 RESULTS

After accounting for drop-out and incomplete data, a total of 35 participants were included who had dietary records at three time points and a measure of total GWG (n=22 EX, n=13 NEX). The NEX women consisted of n=10 intervention and n=3 control participants, while the EX group included n=9 control and n=13 intervention.

Descriptive statistics of the EX and NEX GWG participants are presented in Table 8. The majority of the women were 28-34 years, Caucasian, married, university educated, and from high-income households. It should also be noted that the 13 NEX women consisted of 2 participants under the IOM guidelines and 11 who met the guidelines (n=2 normal weight, n=6 overweight, n=5 obese).

Dietary intakes for the groups along with group, time and group-by-time interactions (ANCOVA, adjusted for MVPA) are reported in Table 9. Energy, fat and protein intakes all significantly decreased across pregnancy in the NEX group ($p < 0.05$). Significant group-by-time interactions were found for energy and protein intake.

Table 8 reports the median values with ranges of BMR, these values were clinically measured for intervention group only (control group BMR values were calculated using the Pennington Biomedical Research Center online calculator [93]). Actual energy intake is also reported in Table 8 as moderate to vigorous PA (MVPA) for women in each group. Effect size (ES) was also calculated to assess the magnitude of the relationship between the weight gain groups ($ES = [\text{mean posttest} - \text{pretest mean}] / \text{pooled SD}$). Moderate and large ES include a significant decrease in fat (-0.76), carbohydrate (-0.55), energy (-0.73) and protein (-0.78) in the NEX group across pregnancy.

5.7 DISCUSSION

All women reported excessive intakes of CHO (257.4g-291.3g), PRO (77.1g -90.1g) and sugar (98.8g -124.0g) but stayed within guidelines of 25-35% total fat/day with reported intakes of between 32.2%- 33.5% regardless of final weight gain. The high incidence of excessive GWG

paired with high energy intakes well above the recommendations can lead us to believe there may be an association.

The significant group-by-time interaction found for energy and protein intake, as well as the NEX group lower reported energy intake (Fat and CHO), can lead us to speculate that these dietary components may play a crucial role in weight management during pregnancy.

The group by time interaction regarding energy and PRO intake illustrated in the NEX group leads us to believe that these dietary factors contribute to a more favourable weight gain pattern in pregnancy. This is in agreement with the Thangaratinam et al. meta-analysis that also found maternal diet, specifically in terms of high total energy intake is a risk factor for excessive GWG [24, 69]. More research is needed to attribute specific contributors of energy intake (fat, CHO etc.) to weight management in pregnancy.

Women in the current study reported consuming a diet whose composition is comparable to that of the general non-pregnant population [108] and previous studies addressing macronutrient intakes in pregnancy and optimal GWG have reported similar amounts for non-excess weight groups[55]. Energy intake patterns of the EX and NEX women are similar to those described in Chuang et al. where 11 NEX and 18 EX women from Pennsylvania, USA participated in qualitative phone interview on diet and physical activity habits during pregnancy. NEX women reported reduced energy intake in pregnancy[109]. Another similar study by Stuebe et al. also reported lower energy intake in the NEX group after completion of a Food Frequency Questionnaire (FFQ) at two time-points in pregnancy (2060 kcal $\pm$ 593) for NEX and 2131 kcal $\pm$ 70) for EX) [110], although the FFQ holds lower reliability than the 7-day food records used in our study.

Overall, diet intakes in the NEX women in the present study were lower for all macronutrient components at V3 compared to baseline, indicating a trend toward

recommendations (except for fibre intake at V3, which declined after V2 (24.6g -23.8g)). In particular, fat, energy and PRO all significantly decreased across pregnancy ($p < 0.05$), with complimentary ES values (a moderate ES was found for CHO (-0.55), suggesting a potential within group significant decrease throughout pregnancy with a larger sample). The EX group experienced improved diet at V2 (with a trend toward recommendations in all intakes except CHO and fibre). However, nutrient intakes increased in all items, including sugar from V2 to V3, with amounts spiking above baseline for energy, fat, CHO and PRO. In addition, although not a significant change, the NEX group reduced CHO across pregnancy (287.9g-257.4g) while the EX group increased intake (275.6g-291.3g).

The NEX group reported lower CHO intakes than the EX group, although not statistically significant. This is in agreement with the literature on success of low-carbohydrate diets in promoting weight loss in non-pregnant populations [22]. Weight loss in pregnancy has been shown to be detrimental to the fetus, thus we do not want to promote restrictive diets during pregnancy. In addition, high protein intakes have also been reported in a number of pregnancy diet studies as controlling weight gain [111, 112]. In comparison, there is little research on CHO intake and its effect on GWG in women; therefore, we cannot comment or conclude what CHO diet composition is best for gestational weight management or healthy fetus growth at this time.

The PRO recommendations for pregnant women (71g/day) have been under investigation in recent years with suggestions of a need for updated intake targets based on body weight and stage of pregnancy. In a study using stable isotopes, Stephens et al. calculated protein requirements (based on body weights) at two time points during gestation [113] and found that a mean intake of 79 g/d during early gestation and 108 g/d during late gestation was optimal for

the study population [79, 114]. Using the Stephens' (2015) proposed protein intake targets as comparison (to the current Health Canada recommendations) in this study, changes in the number of women 'meeting' the requirements are seen in both EX and NEX women. EX women met the PRO recommendations for V2 when using the Stephens updated targets (compared to being classified as "under the recommendations" when referring to Health Canada Guidelines) (79.0 g) and both EX and NEX groups would be considered "under recommended intake" (instead of over when using Health Canada Recommendations) for V3 (77.2g and 85.7g). Further research is needed to confirm if altering intakes based on pre-pregnancy BMI and including trimester specific amounts improves weight management.

It is interesting to note that, although energy intakes were much higher than measured or calculated BMR, women in the NEX group (Figure 6) were still able to maintain GWG within or below the IOM guidelines. A contributing factor could be the role of physical activity. The importance of PA is described in a report from the Ministry of Health and Long-Term Care, outlining the development of obesity in the general population [115] and a recent review demonstrated that PA reduces excessive GWG [55]. As indicated in Figure 7, NEX women consumed more kcal per day (well above BMR, which also accounts for an additional of +340 kcal and +450 kcal per day in the second and third trimester), albeit not significantly more. They also had higher MVPA, which coincided with their higher MVPA (again not significantly higher) (Intervention; V1 (21.5 min/day), V2 (19.8 min/ day), V3 (4.0 min/day) when compared to Control; V1 (11.95 min/day), V2 (11.0 min/day), V3 (14.2 min/day) therefore pointing to PA as a major contributor to GWG maintenance.

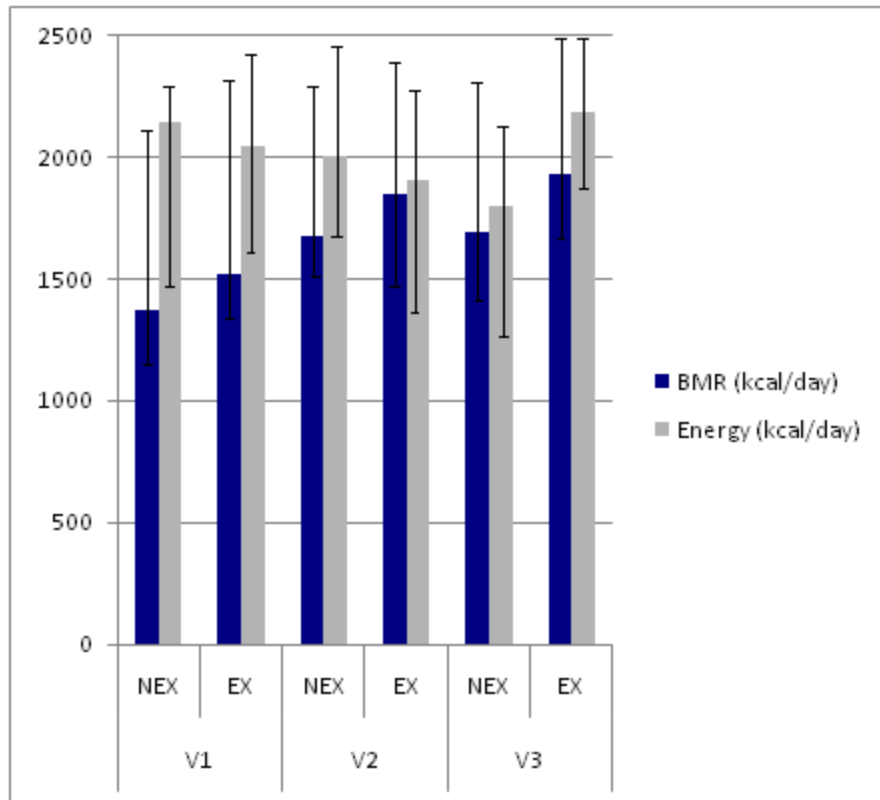


Figure 6: BMR and actual energy intake of EX and NEX women

Basal Metabolic Rate (BMR) – reported in number of Kcal/ Day

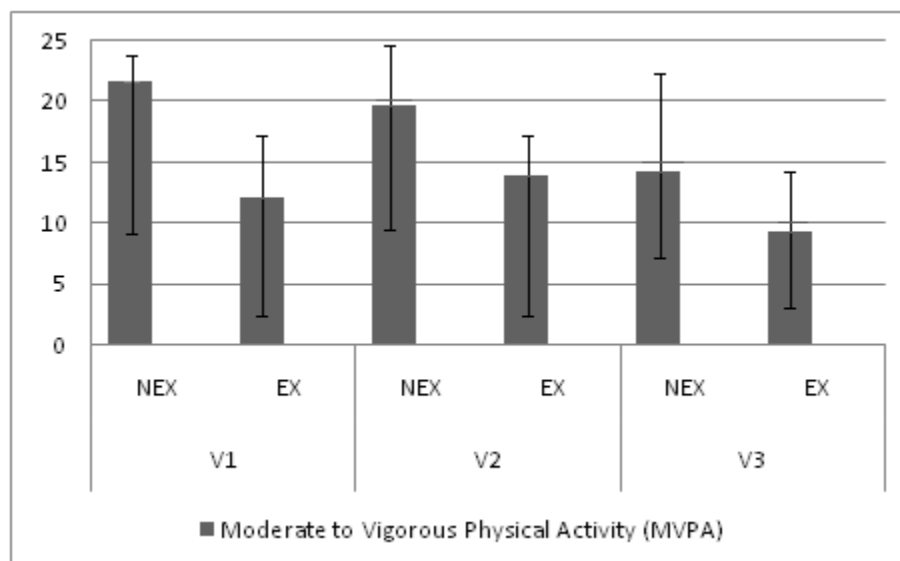


Figure 7: MVPA of EX and NEX Women

Average minutes per day of measured Moderate to Vigorous Physical Activity

Limitations of this study include the use of self-reported dietary intake; self-reported data may be exaggerated or under-reported and various biases may affect the information (social desirability bias or Hawthorne effect)[26, [97]. This study used 7-day dietary records to reduce the issues with self-report, as this method was known as the gold-standard for dietary data collection at the time [98]. While we completed rigorous data auditing to reduce data entry error, this remains a potential limitation. It is important to note that changing the intake of one nutrient may result in altering the intake of another, therefore, macronutrient dietary data alone without addressing other environment factors or health behaviors should be addressed with caution. A final limitation includes the use of calculated and measured BMR as a baseline comparison of energy requirements. Although BMR has been considered the largest component of total caloric expenditure [116], we must consider that variation in physical activity levels, and energy expenditure through thermogenesis make it difficult to estimate the dietary consumption any particular individual needs for optimal weight gain in pregnancy.

5.8 CONCLUSION

This pooled-analysis aimed to identify dietary changes in women whose GWG was excessive vs. non-excessive GWG, showed that women in the NEX group reported decreasing energy intake throughout pregnancy and a significant group-by-time interaction was found for total energy intake and PRO. Overall, the results indicate that as pregnancy progressed, NEX women altered their dietary intakes in a direction toward optimal amounts. Although not a significant change, there was a demonstrated trend (SE of -0.55) towards a reduction in CHO intake across pregnancy within the NEX group, (287.9g to 257.4g) while the EX group increased intake (275.6g to 281.7g) (non-significant).

As would be expected, our results imply that total energy intake within current recommendations is associated with improved weight management in pregnancy and reduced risk for GWG above the 2009 IOM GWG guidelines. Total energy intake (total fat and PRO intake, in particular) deserves consideration in future dietary research as possible excess GWG contributors. Research and development of pregnancy targeted weight management mobile health applications would be beneficial in reducing participant burden and allowing women to report information and participate in when able. In addition, the development of an updated tool that explores women's perceptions of the current IOM guidelines and reported barriers to achieving recommended gestational weight gain may be necessary to understand this population and to develop better pregnancy centered weight interventions and education tools. The reported evidence demonstrating the potential role of energy intake (Fat and CHO) in pregnancy contributes to the body of knowledge on the effects of diet on weight gain in pregnancy.

Table 8: Descriptive statistics (comparing NEX and EX) (N=35)

Descriptive	Non-Excessive (n=13)	Excessive χ (SD) (n=22)	Mann-Whitney U test
Age			P= 0.84
	32.7 (4.2)	31.1 (3.9)	
Descriptive	Non-Excessive N (%)	Excessive N (%)	Pearson Chi Sq.
Intervention distribution			P=0.28
Intervention group	10(77.7%)	13 (53.1%)	
Control group	3 (22.2%)	9 (46.9%)	
Pre-pregnancy BMI			P=0.01
Normal	2 (50.0%)	4(9.4%)	
Overweight	8 (27.7%)	8 (50%)	
Obese	3 (22.2%)	9 (40.6%)	
Ethnic group			P= 0.76
White	14 (77.7%)	26 (81.2%)	
All other ethnicities	4 (22.2%)	6 (18.8%)	
Marital status			P= 0.62
Married	15 (83.3%)	20 (81.3%)	
Other marital status	3 (16.6%)	2 (18.7%)	
Education			P=0.31
University	12 (77.7%)	15 (78.1%)	
Less than University	2 (22.2%)	7 (21.9%)	
Occupation			P= 0.53
Employed	10 (83.3%)	16 (84.4%)	
Other employment status	3 (16.6%)	5 (15.6%)	
Residence			P= 0.28
House	12 (66.6%)	15 (46.9%)	
Other residence	1 (33.3%)	8 (53.1%)	
Income			P= 0.27
< 100,000	10 (55.5%)	10 (62.5%)	
>= 100,000	3(44.4%)	12 (37.5%)	

Table 9: ANCOVA (adjusted for MVPA) Dietary intakes at visit 1 (V1), visit 2 (V2) and visit 3 (V3) in NEX and EX groups

	Non-excessive (n=13)			Excessive (n=22)					
Variable	V1	V2	V3	V1	V2	V3	Group (p value)	Time (p value)	Group X time (p value)
Energy (kcal/day)	2348.0±382.1	2078.1±429.9	1953.4±417.2_a	2080.3±468.4	2001.3±491.4	2188.0±457.1	0.982	0.308	0.042
Fat (g)¹	84.3±11.9	76.4±17.3	72.9±14.2_a	76.1±21.2	70.4±20.2	79.6±19.7	0.643	0.103	0.087
Fat (% energy)¹	33.5±3.1	32.2±3.4	33.2±3.9	34.5±4.8	30.7±5.8	32.2±4.8	0.362	0.126	0.928
Sat. Fat (g)	28.1±5.2	24.7± 6.9	24.7±6.7	27.2±9.2	24.4±7.7	26.4±7.1	0.963	0.248	0.581
CHO(g)¹	287.9±59.8	271.2±68.4	257.4±69.2	275.6±71.0	281.7±77.8	291.3±76.6	0.716	0.752	0.143
PRO(g)	90.1±22.3	89.3±16.6	77.1±15.8_{ab}	82.2±17.0	81.8±18.2	86.4±20.7	0.638	0.249	0.013
Fibre(g)	26.8±10.8	24.6±7.4	23.8±6.5	21.7±6.7	20.7±7.3	24.1±6.8	0.134	0.435	0.152
Sugar(g)	105.6±33.7	102.4±32.6	98.8±33.6	110.0±30.5	111.4±42.5	124.0±48.9	0.355	0.996	0.733

a - difference from V1 (p<0.05)

b - difference from V2 (p<0.05)

¹ Fat, Fat% and CHO are reported in mean and SD (normally distributed data). All others are reported in median and minimum-maximum (range) (non-normally distributed data).

²Fat % is reported in percent of total dietary intake

³Energy intake is reported in kilocalorie intake

Sat. Fat = saturated fat, CHO =carbohydrate, PRO =protein.

Table 10: Effect Size for EX (between visits), NEX (between visits) and EX vs. NEX at same visit

	NEX (n=18)			EX (n=32)			EX vs. NEX		
Variable	V1xV2	V2xV3	V1xV3	V1xV2	V2xV3	V1xV3	V1	V2	V3
Energy	-0.40	-0.30	-0.73α	-0.16	0.39	0.24	-0.24	-0.11	0.35
Fat	-0.52	-0.20	-0.76α	-0.32	0.46	0.13	-0.27	-0.21	0.23
Fat%	-0.41	0.27	-0.09	-0.36 α	0.28	-0.07	-0.28	-0.33	-0.23
Sat. Fat	-0.27	-0.20	-0.47	0.01	0.20	0.23	-0.14	0.04	0.30
CHO	-0.41	-0.12	-0.55	-0.33	0.28	-0.08	-0.07	-0.10	0.17
PRO	-0.13	-0.75	-0.78ab	-0.02	0.24	0.22	-0.34	-0.28	0.32
Fibre	-0.22	-0.19	-0.38	-0.16	0.31	0.17	-0.44	-0.41*	-0.07
Sugar	-0.08	-0.12	-0.19	0.04	0.08	0.13	0.09	0.14	0.24

All $\geq$ moderate effect sizes are highlighted (moderate: 0.51-0.80; large: >0.80),

* Shown difference between groups for same time point ($p<0.05$)

α - shown difference from V1 ($p<0.05$)

b - difference from V2 ($p<0.05$)

Chapter 6

PREAMBLE TO MANUSCRIPT 2

Even though women in the MOM trial intervention group given the opportunity to attend expert led, evidence-based PA and dietary classes at no cost, compliance was low indicating that participants were not as receptive to interventions as one may have desired. The reasons for this are not entirely clear, but this indicated to us that we need to better capture women's feelings, knowledge and expectations surrounding GWG and health behaviours in pregnancy. Thus we wanted to identify a way to gather women's insight and perspectives on GWG and the behaviours that contribute to meeting or exceeding guidelines. We know that the currently available questionnaires that were created to collect information on women's behaviours and knowledge of various pregnancy recommendations (PA, diet, GWG) are out of date. Given the rather dismal statistics regarding excessive GWG, either women are not receiving the correct information, they perceive targets as unrealistic and subsequently ignore them, or are unable to engage in behaviours that will support healthy weight gain. An updated tool is needed to provide appropriate knowledge on pregnancy risks relating to diet, PA and excess GWG. A questionnaire that will easily allow health care providers to collect information to target women who may be at risk of excess GWG and gain information that could help better guide their counseling efforts.

Manuscript 2 outlines the second objective of this thesis; to develop and obtain preliminary validation and test-retest reliability of a comprehensive questionnaire to assess women's attitudes and behaviours surrounding the current IOM weight gain guidelines during pregnancy. The manuscript titled, *“Development and Preliminary Validation of a Comprehensive Questionnaire to Assess Women's Knowledge and Perception of the Current*

Weight Gain Guidelines during Pregnancy” outlines the creation of a tool that can be used to enhance research and improve future maternal health and GWG interventions.

The consideration of psychosocial theories and past frameworks can guide the development of new questionnaires. For the development of the EMat Health Survey, we consulted various theoretical frameworks when developing the constructs covered in the questionnaire decided to base to final questionnaire off the Social Cognitive Theory (SCT). Theories or models most often mentioned in the literature review included; the Theory of Planned Behaviour [117, 118] (TPB), the Social Determinants of Health Model (SDH), the Health Belief Model (HBM) [119] and the SCT[120-122], these are further outlined below.

6.1 THEORETICAL FRAMEWORKS APPLICABLE TO MATERNAL HEALTH

6.1.1 Theory of Planned Behaviour

The TPB is a social-cognitive based framework suggesting that a person's belief about a specific behaviour influences their attitude toward that behaviour. The TPB concepts include; motivation to fulfill wishes and desires of others (i.e., subjective norm or social network) and perceived difficulty to adopt the behavior (i.e., behavioral control). The TPB does not account for variables that affect behavioral intention and motivation, such as fear past experience (i.e. weight gain in a previous pregnancy).

6.1.2 Social Determinants of Health Model

Multiple aspects of the SDH model help us to better understand why individuals engage in certain health behaviours [123]. A number of researchers have used the SDH model to look at general influences on GWG and to study different aspects of weight gain in women. It is important to note, however, that the SDH encompass an over-arching framework that does not

focus specifically on maternal psychosocial factors such as self-efficacy, perception, experience or any potential behaviour change factors. Understanding self-efficacy and its impact on a mother's health behaviours as well as perception of 'allowable' weight gain is important as effective interventions to achieve appropriate GWG have been designed to increase mothers' self-efficacy related to weight gain[13, 124].

6.1.3 Health Belief Model

The HBM, also similar to the above models, addresses a person's self-perceived susceptibility, severity, benefits and barriers as well as self-efficacy regarding health behaviour. Unlike the others, The HBM has no strict guidelines as to how the variables predict behaviours and does not address the effect of environment on behaviour.

6.1.4 Social Cognitive Theory

After reviewing the literature it was determined that the SCT, a framework that includes all key methods that influence behaviour, should be used to develop a comprehensive questionnaire that will aid in identifying women who may be at risk of excess GWG and discover steps that can improve the health of those at risk [122]. The SCT describes predictive and modifiable factors associated with behaviour change [125]. The core concept in SCT is "Reciprocal Determinism", which refers to the dynamic and shared interaction of person (learned experiences), environment (social context), and behavior (responses to information and advice), which in combination, produce a behaviour [122]. Although there are multiple constructs within SCT, the following three variables are highlighted in health behaviour change studies and considered modifiable: outcome expectations (can be influenced by the outcome or behaviours of others), perceived barriers to achieving wanted behaviour, and self-efficacy[122, 126].

Overall, the development of this questionnaire, and data collected from its use, will aid future research in the area of gestational weight gain and women's knowledge and perception of the current weight guidelines. The following manuscript has been formatted and will be submitted to the *International Journal of Environmental Research and Public Health* as a "special article".

Chapter 7

MANUSCRIPT 2: DEVELOPMENT AND PRELIMINARY VALIDATION OF A COMPREHENSIVE QUESTIONNAIRE TO ASSESS WOMEN'S KNOWLEDGE AND PERCEPTION OF THE CURRENT WEIGHT GAIN GUIDELINES DURING PREGNANCY

Special Consideration Article

Development and Preliminary Validation of a Comprehensive Questionnaire to Assess Women's Knowledge and Perception of the Current Weight Gain Guidelines During Pregnancy

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To be submitted for consideration of publication

7.1 ABSTRACT

The aim of this study was to develop and validate responses to an electronic questionnaire, the *Electronic Maternal Health Survey (EMat Health Survey)*, related to women's knowledge and perceptions of the current gestational weight gain guidelines (GWG), as well as pregnancy-related health behaviours. Constructs addressed within the questionnaire include self-efficacy, locus of control, perceived barriers and facilitators of physical activity and diet, outcome expectations, social environment and health practices. Content validity was examined using an expert panel ($n = 7$) and pilot testing items in a small sample ($n = 5$) of pregnant women and recent mothers (target population). Test re-test reliability was assessed among a sample ($n=71$) of the target population. The calculated reliability scores (Pearson r and Intraclass Correlation Coefficients (both >0.5)) were acceptable for all constructs. The content validity of the questionnaire reflects the degree to which all relevant components of excessive GWG risk in women are included. Strong test-retest reliability was found in the current study, indicating that responses to the questionnaire were reliable in this population. The *EMat Health Survey* adds to the growing body of literature on maternal health and gestational weight gain by providing the first comprehensive questionnaire that can be self-administered and remotely accessed. The questionnaire can be completed in 15-25 minutes and collects useful data on various social determinants of health and GWG as well as associated health behaviours. This online tool will also assist health care providers by providing them with a platform to collect useful information on how to better support women to gain recommended weight in pregnancy.

Keywords: Maternal Health questionnaire; Health Questionnaire Development; Questionnaire Validation; Gestational Weight Gain Knowledge; Gestational Weight Gain Perceptions; Maternal Health Behaviours

7.2 INTRODUCTION

The rise in obesity prevalence is disproportionately affecting women of childbearing age[127]. A recent review of health measures surveys indicated that 48.2% of Canadian women are at a weight higher than considered healthy (Body Mass Index (BMI) ≥ 25), which is up from 44.6% in 2001[1]. As BMI has increased among the general population over time, so too has the number of overweight (OW) or obese (OB) women presenting for obstetric care, causing challenges and concerns for health care providers (HCP) [6]. Compared to those with a normal BMI, women who enter pregnancy already OW or OB are more likely to gain weight in excess of evidence-based guidelines [128], which can lead to poor antenatal and postpartum outcomes [7]. The healthy weight gain targets for pregnancy, released by the Institute of Medicine (IOM), are based on pre-pregnancy BMI and were developed in hopes of reducing the number of pregnant women gaining excessive weight and experiencing negative health consequences as a result [2].

Since these guidelines were updated in 2009, it has been reported that over 60% of pregnant women continue to exceed weight targets[11]. GWG within recommended guidelines, has been associated with healthy pregnancy and positive outcomes[2]. Inadequate GWG has been linked to an increased risk of preterm birth and delivering an infant with fetal growth restriction in some studies [129], whereas maternal pre-pregnancy obesity and excessive GWG are independently associated with increased birth weight, macrosomia [130], GDM, C-section and giving birth to an infant who is large for gestational age (LGA)[11, 37].

The high prevalence of excess GWG and its potential to contribute to adverse outcomes highlights the importance of developing tools that will help health practitioners identify strategies to guide women to achieve optimal weight gain during pregnancy. Despite a plethora of research describing complications related to excess GWG[37, 131, 132], only a small number of studies have assessed women's knowledge about the updated IOM GWG guidelines [133, 134]. To our knowledge, there are no

published, validated tools developed to collect information on women's perceptions of the current IOM guidelines or to examine reported barriers and facilitators contributing to GWG. Exploring women's perceptions regarding these issues is important in order to assess the knowledge gaps regarding sub-optimal GWG, to discover potential psychosocial risk factors and to assist practitioners in helping women meet the IOM recommendations [133, 135-138].

In contrast to the minimal data available on women's knowledge and perception of the effects diet and exercise may have on pregnancy weight gain, there is well documented consensus about the overall effects of energy intake and expenditure on weight gain and loss [139]. Health Canada's Healthy Weights Report states that healthy eating and physical activity (PA) practices are important for both weight management and general health [140] and several studies provide evidence to demonstrate that PA during pregnancy is beneficial for both mom and baby [80, 141]. Therefore, dietary guidelines have been developed that outline the required changes in energy and nutrient intakes as pregnancy progresses [77]. A recent Cochrane review on GWG interventions using diet, exercise or both reported success in reducing the risk of excessive GWG by 20% overall (average risk ratio (RR) 0.80, 95% confidence interval (CI) 0.73 to 0.87; participants = 7096; studies = 24; $I^2 = 52\%$) [24].

Although the current IOM guidelines have been widely available, recent literature suggests that women are not being appropriately counseled on GWG targets [44, 142]. Specifically, it was reported that women of healthy weight are more likely to be given information in accordance with the recommendations (86.8%) than women who were overweight (12.5%) or obese (26.3%) [10]. It is currently unknown whether women who are given appropriate guidance still experience excessive GWG. If this is the case, further research on women's perceptions and self-efficacy of the IOM weight targets is needed as perception has been shown to affect motivation and, thus, success for weight management [143]. Subsequently, such information might be able to justify the provision of information to women and

perhaps lend credence to the development of new methods of intervention that target barriers to weight management in pregnancy[10, 44, 57].

The current study had two objectives: 1) develop a self-administered, web-based, comprehensive questionnaire (i.e., online survey) to examine influential factors of weight gain among pregnant women that can be incorporated into both clinical practice and future research, and, 2) establish initial content validity and evaluate test-retest reliability of scores from the questionnaire among a sample of pregnant women and recent mothers. We hypothesized that responses to the questionnaire will demonstrate validity evidence based on content validity via an expert panel review and pilot testing items with the relevant population as well as reliability assessed by a 14 day test-retest pilot study.

7.3 MATERIALS AND METHODS

7.3.1 Questionnaire development

The development of the comprehensive questionnaire was conducted in eight steps, as detailed below.

1. Literature review and identification of risk variables: A literature review was conducted to identify other validated questionnaires that were already available to evaluate pregnancy weight management barriers, facilitators, and women's perceptions of the updated IOM guidelines.

There were no questionnaires found in our review that used the correct, updated gestational weight gain guidelines.

2. Establish a theoretical framework: Many psychosocial theories of health behaviour have been used in developing health-related questionnaires. The literature review showed that theories or models most often used included; the Social Cognitive Theory (SCT)[120-122], the Theory of Planned Behaviour [117, 118] and the Health Belief Model [119].The SCT offers both predictors and principles and an ability to identify important knowledge gaps [122] Subsequently, it was

determined that the SCT, a framework that includes all key methods that influence behaviour, should be used to develop our comprehensive maternal health questionnaire related to GWG and associated health behaviours. [122]. The SCT describes predictive and modifiable factors associated with behaviour change [125]. The core concept in SCT is *reciprocal determinism*, which refers to the dynamic and shared interaction of person (learned experiences), environment (social context), and behavior (responses to information and advice), which in combination, produce a behaviour [122]. Although there are multiple constructs within SCT, the following three variables are highlighted in health behaviour change studies and are considered modifiable: outcome expectations (can be influenced by the outcome or behaviours of others), perceived barriers to achieving wanted behaviour, and self-efficacy [122, 126].

3. Development of a draft questionnaire: The questionnaire was structured so that participants who were currently pregnant answered questions based on current behaviours, while postpartum women answered the questionnaire based on retrospective behaviours during their most recent pregnancy within the past six years. Women who reported both currently being pregnant and having birthed a child within the past six years, were prompted to complete both the pregnancy and the postpartum questions (all questions related to current pregnancy were asked first, followed by those relating to past pregnancy). A draft questionnaire containing a pool of 110 items was developed based on key psychosocial predictors of GWG that were identified in the literature review and guided by components of the SCT (*self-efficacy, locus of control, perceived barriers, outcome expectations and social environment*). Pregnancy specific weight gain interventions have shown that *knowledge* of lifestyle recommendations (including GWG, diet and PA) and *health practices* were also key predictors in amount of weight gained while pregnant [144] and thus, were also included as a constructs. Next, we examined the 110 original

items (approximately 50 on current pregnancy and 60 on previous pregnancy), divided within the 7 constructs, and removed duplicate items and any item that was ambiguous. Additional questions addressing post pregnancy health plans (i.e., breastfeeding practices) were added, resulting in approximately 80 items total (30 on current pregnancy and 50 on past pregnancy).

Most questions on perceived weight and GWG factors were unique to this study. Some items were developed based on existing questionnaires, that are now considered out of date (i.e., use the 1990 IOM guidelines). For example, the *Pregnancy and Weight Gain Attitude Scale* (PWGAS) [145], comprises 18 items about weight-related attitudes (15 items) and behaviors (3 items) during pregnancy and references the outdated IOM guidelines and terminology, questions were adapted to reflect the 2009 GWG targets[145]. The *Pregnancy Experience Scale* (PES) [146], which was developed to measure maternal appraisal of exposures to 41 potential hassles specific to pregnancy, only includes 1 item that addresses weight, this item was adapted for current context in the present questionnaire. PA behaviour was assessed with questions based on the Leisure Time Exercise Questionnaire [147], the items were adapted to assess the number of times per week the participant engaged in light, moderate, and vigorous exercise rather than number of bouts. The final version of the questionnaire had 8 sections with 80 items in total. It incorporated all predictors of weight gain (Section 1: Inclusion/ Exclusion; Section 2: Demographics; Section 3: Health Practices; Section 4: Pregnancy Weight; Section 5: Physical Activity; Section 6: Diet; Section 7: Pregnancy Intentions and / or Pregnancy Practices; Section 8: Diet and Weight Gain Perceptions) (further described in table 1).

4. Expert panel feedback: An expert panel (n=7) was established and included a clinical psychologist with specialization in health behaviour, a qualitative researcher in women's health with expertise in socio-cultural aspects of behaviour, a physiologist with expertise in nutrition

and PA in pregnancy, a clinician specializing in internal medicine/obstetrics, two maternal health research experts, a pregnant woman, and a recent mother. During the development phase, the expert panel commented on several versions of the questionnaire items to improve content validity. Once content was approved by the expert panel, the questionnaire was created using the REDCap electronic data capture tool hosted at the Children's Hospital of Eastern Ontario Research Institute (CHEO RI) [148].

5. Pilot study and questionnaire revision: A preliminary version was pilot-tested on a convenience sample of five consenting women (2 currently pregnant and 3 who had been pregnant after May, 2009, all single fetus pregnancies). For the pilot, the questionnaire took approximately 15-25 minutes to complete, depending on whether the participant was currently pregnant, postpartum, or both. The questionnaire was available in English only. Women reported any misleading and confusing questions by email to the author. Suggestions from the pilot participants included, adding options for types of diet, simplify wording for some questions and removing potentially repetitive questions on PA. All reported feedback was emailed to the lead author, documented, and addressed. Questions were removed or adapted based on suggestions.

6. Questionnaire validity: Content validity was established through the incorporation of suggestions from various experts who have contributed to the development of the questionnaire (via expert panel). The content validity of the questionnaire reflects the degree to which all relevant components of excessive GWG risk in women are included[149]. By addressing content validity, we also ensured that less relevant variables were excluded to reduce participant burden[149].

7. Two time points study to assess test re-test reliability: Participants completed the self-administered computer-based questionnaire and were prompted to accept informed consent via

an online form before beginning. Women who identified as either i) currently pregnant or ii) birth after May, 2009 (time of IOM GWG updated guidelines released) with a single fetus were eligible to participate. Women currently pregnant were asked to complete approximately 30-40 items, while women who reported giving birth after May, 2009 completed 45-55 items. The survey was built using branching logic to avoid redundancy and to capture subject-specific information. For example, women who reported no current pregnancy were directed via branching logic past the items on current pregnancy to the past pregnancy section only. As part of the validation study, for items where "other" was a chosen answer option, an ensuing question was available for text description. The only question where participants entered typed information for "other" was in response to an item addressing dietary information from their HCP. As a result, an item was added to include the options listed from validation study participants (i.e., the options "increase the amount of fiber" or "decrease the amount of fiber" were added). The content validity team also decided to change the order of some indicators to allow for better flow of the questionnaire (vitamin, smoking and alcohol intake items were moved from health practices to diet section). Test-retest reliability of the questionnaire was assessed using measures recorded at a 2-week (14-day) interval. Participants were contacted (via auto response email, with link to re-test survey) and prompted to complete the same questionnaire on the same day of the week. Two reminder e-mails were sent to subjects over 6 days to optimize response rates. Data were exported from REDCap into SPSS for analysis.

8. Final version of questionnaire. Based on the results of the previous steps identified above, we created the final questionnaire that can be used in future research.

Table 11: Questionnaire Section Description

Section 1: Inclusion/Exclusion	• Over 18 years old • Currently pregnant or • Birth of child after May 2009 • Single fetus pregnancies
Section 2: Demographics	• Age • Height(ft./in or cm) • Weight (kg or lbs.) (if currently pregnant, women were asked for current weight and pre-pregnancy weight) • Location of received healthcare • Household income • Ethnicity • Marital status • Education
Section 3: Health Practices (current and/or past pregnancy) (9 items)	• Health care location (2 items) • Health care provider GWG counseling (2 items) • Alcohol and tobacco use (2 items) • Birth center preference (1 item) • Medical condition or medication (2 items)
Section 4: Pregnancy Weight (current and/or past pregnancy) (8 items) Adapted from Palmer, 1985[145]	• Weight self-perception (2 items) • Gestational weight gain recommendation knowledge (2 items) • Social network advice (2 items) • Facilitators and barriers to pregnancy weight management (2 items)
Section 5: Physical Activity (PA) (current and/or past pregnancy) (12 items) Type of PA (3 items) were adapted from Godin, 1985[147]	• Type of PA (3 items) • PA plans and practices (4 items) • Facilitators and barriers to PA in pregnancy (2 items) • Health care provider advice (1 item) • Social network advice (2 items)
Section 6: Diet (current and/or past pregnancy) (11 items)	• General diet habits (4 items) • Pregnancy diet recommendation knowledge (3 items) • Any specific diet (2 items) • Health care provider advice (1 item) • Social support advice (1 item)
Section 7: Pregnancy Intentions (for current pregnancy) and / or Pregnancy Practices (for past pregnancy) (8 items)	• Birth plans (2 items) • Breastfeeding or infant feeding plans (2 items) • Health care provider breastfeeding support (2 items) • Prenatal education class participation (2 items)

Section 8: Diet and Weight Gain Perceptions (current and past pregnancy) (14 items) 1 item adapted from DiPietro (2002) [145]	• Locus of control (of weight gain in pregnancy) (2 items) • Locus of control of diet (2 item) • General weight gain in pregnancy questions(2 items) • Perceived success of attaining IOM GWG recommendations (3 items) • Feelings of facilitators and barriers to weight discussions with health care provider (2 items) • Postpartum weight retention (for those who reported past pregnancy only) (3 items)
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7.3.2 Data collection and Management

A priori power analysis was calculated using G*Power. Based on alpha = 0.05, power = 0.80, and specifying a moderate correlation = 0.3, the required sample size for the current investigation was n=67). Study data were collected and managed using REDCap, a secure, web-based application designed to support data capture for research studies, providing, 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources[150].

Participants were recruited through social media websites. A Facebook page and Twitter postings were created to promote the study to the target population. The postings included a link to the REDCap website. Women who clicked the link were directed to the consent form for more information on the study and, after completion of consent, were able to begin the questionnaire. A total of 87 women clicked on the public survey link and viewed the online questionnaire consent form. Although no one refused consent, 16 did not complete the consent process. The total number of participants who completed test 1 (T1) was 60 (n=11 incomplete T1 and n=7 drop out after T1 complete). Total number of women who completed both T1 and Test 2 (T2) was n=39 (n=14 incomplete at T2). One study participant gave birth within the 14 day test/re-test

interval and was therefore excluded from the study. The final number of participants included in the final validation analysis was $n=38$ (Figure 1).

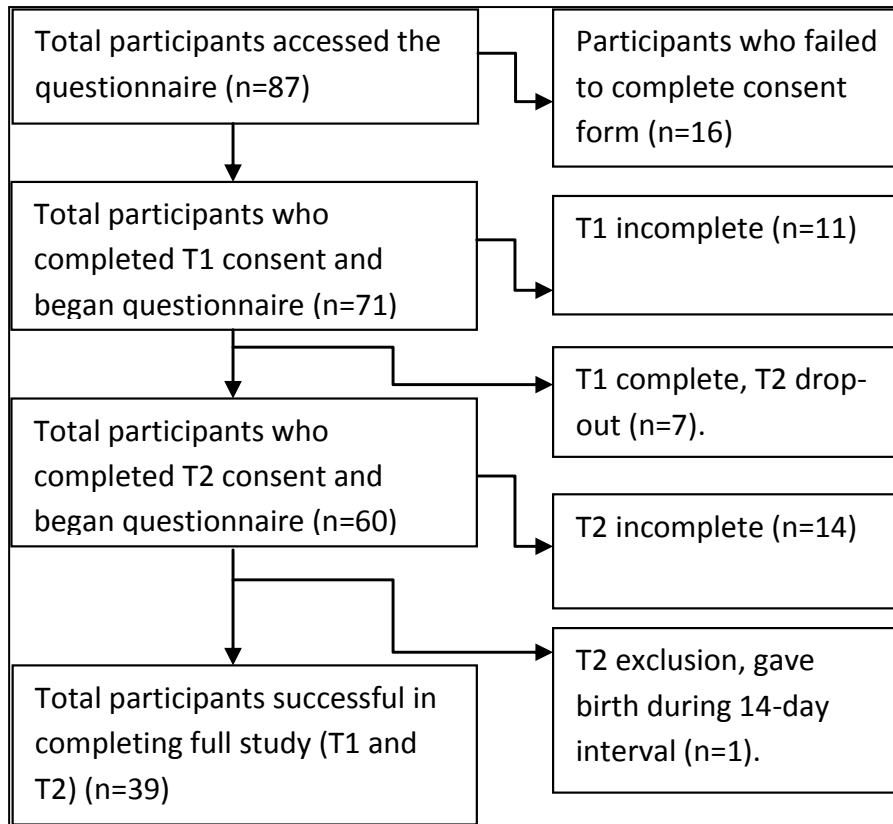


Figure 8: Outline of participants in each phase of test-retest validation study

(Participation rate). T1 =test, T2= re-test 2.

7.4 Ethical Approval

All data collection instruments and procedures were approved by the institutional review boards from the Children’s Hospital of Eastern Ontario Research Institute, Research Ethics Board and the University of Ottawa Ethics Committee (Protocol number: 14/183X). Use of the online questionnaire was considered safe as all answers were stored in the secured REDCap software, where they are privacy protected and confidential.

7.5 Statistical Analysis

All statistical procedures were carried out using SPSS/PC+ (SPSS Inc., Chicago, IL). Single measure intra-class correlation coefficients (ICC) were used to explore the test-retest reliability within the 14-day interval. ICC values were interpreted as very high ($ICC > 0.9$), high ($ICC > 0.75$) or moderate (ICC between 0.5- 0.75) [30]. The ICC is used for measures with several categories or for linear measures, and it is appropriate for use in samples that include non-independent data [151, 152]. Another commonly used method to assess reliability of various health management questionnaires is to examine the Pearson's correlation (r value) of the data between test and retest [153]. The r value was also calculated for all questions to use as a comparison to the ICC. According to Field *et al.*, large correlation coefficients, defined as 0.5 or greater, indicate that the reliability is high[154]. Statistical significance for this study is based on the $p < 0.5$ level for all analyses and specifying a one tailed test of significance. Questions with multiple response options were not included in the ICC or Pearson correlation analysis given that these analyses require the selection of only one response option.

7.6 Results

Participants were 71 pregnant (majority between gestational week 25-29 (32%)) and /or postpartum women (infant born after May, 2009) at 38-41 weeks (78.5%), age 30-34 (44.9%). Most of the participants were Canadian (92%), white (97.4%), married (89.6%), university graduates (79.1%), working full time (79.5%) and earning a family income of \$150,000 or more per year (34.6%). Questions with multiple response options were not included in the ICC or Pearson correlation analysis given that these analyses require the selection of only one response option.

7.6.1 Content Validity

The questionnaire was reviewed by experts in the field to assess content validity. Based on the expert panel suggestions and interpretation of individual items, social support questions adapted from the Maternal Social Support Index (MSSI) items [155] were eliminated and some answer options were changed or reworded. Common reasons for item deletion included: 1) lack of relevance (e.g., concern that adapted MSSI was too long and was not measuring health behaviour or perception that affects GWG) and 2) to combine similar questions in order to reduce the length of the questionnaire (e.g. questions asking for perceived optimal GWG vs. how much a women believes she should gain in pregnancy). On the basis of expert suggestions, we added questions addressing facilitators to weight management, self-efficacy, locus of control and perceived social norms (further discussed below). It was also suggested to add the option of intersex (in addition to male female or unknown) for sex of fetus.

7.6.2 Test-retest Reliability

Pearson's r and ICC values are presented for all items (Table 2). Two correlation measures were used to show both similarity in the sum of responses to an item on test and retest, and the proportion of individual respondents whose responses were the same on both occasions [22]. Correlation coefficients were considered acceptable for most items (> 0.5) for most questions in the questionnaire (Tables 2). Table 3 shows the correlation coefficients, Pearson's r and ICC, for each category of variables measured.

Test-retest bivariate correlations for all items within the *Self-Efficacy* construct (2 items) and many within the *Social Environment* construct (10 items) were >0.05 for Pearson r and ICC. Despite the low test retest reliability of these items, we decided to retain the questions for the final version of the questionnaire because the statistical power of this question was low due to small completion sample ($n=16$) which could have led to an attenuated test retest value. It is

possible that with a larger sample size and more statistical power, the test-retest correlation for this item could have reached recommended levels. Also, the self-efficacy questions were important in fulfilling the objective to collect information on women's confidence in the ability to exert control over their own behaviour and social environment.

There were 6 items analyzed for the *Locus of Control* construct. All but one question within the construct were deemed acceptable (r and $ICC > 0.05$). The question, "Why would you feel most comfortable gaining this amount while pregnant?" ($r=0.215$, $p = 0.201$, $ICC = 0.545$, $p=0.201$) reported a low r value but significant ICC . The decision to keep this question was made as the statistical power of this question may be low due to small sample ($n=10$). If the sample were higher, there is a possibility that this question would be considered significant.

The *Social Environment* construct included a total of ten items. Six items demonstrated a range of reliability (r values ranged from 0.221 - 0.706 and ICC values ranged from 0.220 - 0.702). The remaining 4 items produced low reliability values; these items were removed or reworded.

All items within the *Outcome Expectations* construct (2 items) showed significant reliability ($r= 0.618$, 0.712 and $ICC=0.664$, 0.711 with a $p<.001$ for both). All items were kept within the final questionnaire. The *Health Knowledge* construct includes 14 items. Ten items demonstrated high reliability between test re-test (between a perfect $r=1$, $ICC=1$ and $r=0.615$, $ICC=0.607$, $p=0.04$). Although four items had low reliability, the overall mean of the section ($r=0.625$, $ICC=0.621$) is good and therefore a decision was made to keep the items for further validation studies.

Test-retest bivariate correlations for the *Health Practice / Plans* section (21 items) were considered a range of poor to a perfect correlation (ICC 0.361 to 1.0) and low to perfect (r values

range from 0.417 to 1.0). There were two items that were found to have poor reliability, 1. “How much more/less are you eating (compared to usual pre-pregnancy amount) during your pregnancy?” ($r = 0.417$, ICC: 0.361 $p = 0.202$) and 2. “Comparing your current weight to your weight 1 year pre-pregnancy, how has your weight changed?” ($r = 0.256$, ICC = 0.254, $p = 0.378$). As a whole, the health knowledge construct was considered significant in test-retest consistency. The questionnaire's expert panel suggested keeping the two items with low reliability as answers may have changed to these items as a result of the 14-day re-test window. These items will be further analyzed in future validation studies.

Perceived barriers/ facilitators (2 items): Due to a low sample size ($n = 2$) for this construct a test re-test score was not calculated.

7.7 Discussion

The aim of our study was to develop a comprehensive questionnaire that can be used to examine influential factors of weight gain among pregnant women to allow for use in future research and clinical settings to identify what women report as contributors to appropriate GWG (positive or negative contributing factors to weight management). Our second objective was to evaluate test-retest reliability of response to the questionnaire among a sample of pregnant women and recent mothers. The calculated reliability scores (r values and ICC) of most constructs were considered moderate to high. The lowest reported scores were within the social environment construct, and highest scores from the health practice/plans construct. We have provided initial evidence for test-retest reliability and content validity for this questionnaire, which was designed to assess women's perceptions and behaviours related to GWG. However, more research is needed to examine other aspects of reliability and validity with larger sample sizes to attain greater statistical power.

A strength of this study is the use of rigorous methodology in questionnaire development [156] with the incorporation of an expert panel for to assess content validity. A benefit of the development of this comprehensive questionnaire, especially within maternal health research (for pregnant women or recent mothers), is that a self-administered, remotely accessed questionnaire can be completed at home, at any preferred time thereby allowing for easy, fast recruitment and data collection. The questionnaire can be used in any setting from rural to urban communities[157], both of which have been shown to be at increased risk of exceeding the GWG guidelines for reasons yet to be fully discovered[158]. Our questionnaire could be embedded in several settings, ranging from future health research, clinical use or use in population screening for excessive GWG risk. Nevertheless, given that validation is considered an ongoing process, more research is needed to determine the most efficient way of using this tool and to further examine the validity of response to the questionnaire, the validity of this questionnaire needs to be further assessed.

There are several limitations to be considered in our validation study. One limitation is the low response rate and the large attrition rate from those who originally completed T1 consent to those who finished the final retest (T2). We believe this to be related to women not truly recognizing the need to complete the second questionnaire and thus ignoring the prompts and messages. A second limitation is that the questionnaire is only available in the English language and we do not know how well this questionnaire will perform in English-as-a-second-language speakers or in people with more limited health literacy (i.e., the ability to access, comprehend, evaluate and communicate information as a way to improve health [159]). To reach a wider population, questionnaire items should undergo rigorous language adaptation procedures and responses to the questionnaire in alternative languages should be validated. Similarly, responses to the questionnaire from people with different degrees of health literacy or socioeconomic status' should be validated. Another limitation of the present study is that a convenience sample (mostly white, educated, Canadian women) was used. Although the recruitment

procedures used were open to a wide array of races/education levels, perhaps their lack of participation represents a biased tendency to the completion of questionnaires on GWG. These factors could have affected the interpretation of the results. A further limitation is that "postpartum" women completed the questionnaire after up to 5 years following pregnancy; thus, their responses may have been subject to recall bias. Finally, the small sample size for some constructs and items (i.e., perceived barriers and facilitators construct) may have led to inconclusive test retest results. Future studies should use larger samples and longitudinal data to establish higher reliability scores.

We acknowledge that the *EMat Health Survey* is lengthy. It was designed to be comprehensive in diverse aspects of maternal health related to weight gain. Initially, in order to reduce the length of the questionnaire, only barriers to managing weight, proper diet and adequate PA were included. After consulting with the expert panel it was agreed that in order to ensure a more accurate depiction of the logic behind women's health behaviours, facilitators should also be considered. Facilitator questions were added to address this concern (i.e., You answered "most of the time" or "always" to feeling confident about being able to stay within the weight guidelines suggested by your health care provider. Why do you feel this way?). Additional self-efficacy and locus of control questions were added to include more in-depth questions around these constructs regarding weight gain in pregnancy. The added questions were considered valuable by committee members and the project team. As suggested by committee members, questions were added to address social norms, as this is an important component of the SCT. Social impact has been studied and shown to greatly affect weight beliefs and practices in adults. Yet, the impact they have on weight gain in pregnancy specifically is an area that has limited data. Future studies should evaluate whether the length of the questionnaire makes it a burden to complete and whether shorter versions can be developed, tested for validity and reliability, and used instead of this longer version. The length of the survey may have been the cause of a high loss to follow-up rate between test and retest (45% loss to follow-up). One approach to increasing response and reducing loss to follow-up is

the use of incentives, which has been effective at increasing response rates in surveys [160]. Incentives (such as gift vouchers or lottery participation) have been found to almost double the odds of response to electronic surveys [160] and may be useful in future studies.

Despite these limitations, a strength of this study is the novel basis of our questionnaire, as it is the first known questionnaire aimed to identify women's perceptions of the IOM GWG guidelines and to discover both the barriers and facilitators women report with weight management in pregnancy. The questionnaire is self-administered and can also be accessed on-line, which are additional strengths and add to the diverse future potential applications of the questionnaire in health research and clinical use. This information, once collected could be used overcome limitations of current interventions through the development of new health targets and approaches.

7.8 Conclusion

In conclusion, this online questionnaire to assess women's perception of the current IOM weight gestational gain guidelines has preliminary content validity and test-retest reliability. It is a comprehensive questionnaire that can be implemented in several health care situations in order to increase the detection of women at risk of excessive GWG and address the barriers women report in pregnancy. This study fills gaps in the existing literature related to the lack of reliable and valid instruments available to gather information about weight gain perceptions of women in pregnancy, as well as knowledge of and engagement in healthy prenatal lifestyle behaviours. However, although we have provided initial evidence for reliability and content validity, the most efficient way of using this tool and the validity of this questionnaire needs to be further assessed. Maternal obesity and excessive GWG have the potential to cause significant consequences for population health and obstetric care, resulting in the continuation of the obesity

epidemic. If we can better understand what is preventing women from gaining appropriate weight during pregnancy, we can then work to reduce the impact of excess weight in pregnancy.

Abbreviations

GWG: Gestational Weight Gain

BMI: Body Mass Index

IOM: Institute of Medicine

SES: Socioeconomic Status

OW: Overweight

OB: Obese

HCP: Health Care Provider

ICC: Inter Correlation Coefficient

PA: Physical Activity

HBM: Health Belief model

PES: Pregnancy Experience Scale

PWGAS: Pregnancy Weight Gain and Attitude Scale

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Conflict of Interest: The authors declare no conflict of interest.

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Table 12: Test-Retest Bivariate Correlations for All Constructs

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
Self-efficacy (2)							
Did you feel confident about being able to stay within the weight gain limits provided for your past pregnancy?	18	4.44 (.784)	16	4.50 (.516)	0.472	0.075	0.472 (-.033, .785)
Did you make a focused effort to stay within the weight gain limits given to you by your health care provider?	18	3.11 (1.530)	16	2.75 (1.483)	0.397	0.142	0.396 (-.126, .746)
Locus of control (6)							
Do you worry that you may gain too much weight while pregnant?	24	1.83 (1.167)	24	1.88 (1.191)	0.950**	<0.001	0.950*** (.878, .980)
I would feel MOST comfortable gaining the following amount during my pregnancy:	4	4.00 (1.155)	8	3.88 (0.835)	0.707*	0.293	0.667**(-0.511, 0.974)
I would feel MOST comfortable gaining the following amount if I were to become pregnant:	21	4.14 (1.352)	26	3.85 (1.287)	0.749*	<0.001	0.545*(.147, .791)
Why would you feel most comfortable gaining this amount while pregnant?	28	2.11 (1.571)	26	1.54 (1.208)	0.215	0.201	0.208(-.120, .496)
I am able to control the amount of weight that I gain while pregnant	38	2.68 (1.016)	37	2.62 (0.982)	0.549*	0.012	0.646*(.326, .833)
If I am healthy and exercise, I can control my weight while pregnant.	38	2.26 (1.131)	37	2.41 (1.040)	0.521*	0.001	0.520*(.240, .720)
Outcome Expectations (2)							
Do you think that women should be	38	3.13 (1.119)	37	2.70 (1.077)	0.618*	<0.001	0.617*(.370, .783)

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
careful about gaining too much weight during pregnancy?							
As long as you are eating a well-balanced, healthy diet, do you feel it shouldn't matter how much weight you gain while you're pregnant?	38	4.08 (1.075)	37	3.78 (1.134)	0.712*	<0.001	0.711*(.506, .840)
Social Environment (10)							
Have any of your friends or family members been pregnant in the past 5 years?	38	2.50(.604)	37	2.43 (.835)	0.231	0.168	0.220 (-.108, .505)
If yes, how much weight, on average, did your family members gain while pregnant?	23	4.91 (2.811)	28	5.61(3.059)	0.334	0.129	0.332 (-.094, .656)
If yes, how much weight, on average, did your friends gain while pregnant?	36	5.08 (2.792)	29	5.79 (2.846)	0.651*	<0.001	0.651* (.373, .822)
How do you feel about the amount of weight they gained while pregnant?	36	2.86 (0.351)	37	2.89 (0.315)	0.623*	<0.001	0.620* (.366, .789)
Did you receive advice from your family or friends about how much weight to gain while pregnant?	38	3.55 (0.921)	37	3.38 (1.089)	0.341	0.039	0.337(.018, .593)
Whose advice do you trust the MOST (in regards to weight gain while pregnant)?	38	3.95 (0.324)	36	3.78 (.760)	0.401	0.015	0.295(-.033, .565)
Do you feel it is acceptable to gain as much weight as you want while you	38	2.50 (1.157)	37	2.30 (1.127)	0.555*	<0.001	0.555*(.285, .743)

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
are pregnant?							
How comfortable do you feel discussing your weight and/or weight gain during pregnancy with friends or family members?	38	2.97 (1.000)	37	3.11 (0.774)	0.221	0.188	0.221(-.106, .506)
How comfortable do you feel discussing your weight and/or weight gain during pregnancy with your health care provider?	37	3.32 (0.933)	37	3.32 (0.944)	0.706*	<0.001	0.702*(.492, .834)
Whose advice do you trust the MOST (in regards to diet while pregnant)?	38	1.63 (1.478)	37	1.38 (1.139)	0.113	0.506	0.109(-.219, .415)
Health Knowledge/ Knowledge of Recommendations (13)							
Thinking of your pre-pregnancy weight, what weight did you consider yourself?	12	2.17 (.389)	11	2.18 (0.405)	1.000***		1.000***
Are you following Canada's Food Guide while pregnant?	12	3.25 (1.485)	11	3.82 (1.834)	0.615*	0.044	0.607*(.048, .876)
Before this pregnancy, what weight did you consider yourself?	32	2.25 (0.508)	31	2.29 (0.588)	0.955**	<0.001	0.947*** (.891, .974)
Did you follow Canada's Food Guide while pregnant?	32	3.66 (0.787)	31	3.81 (0.833)	0.753*	<0.001	0.753** (.543, .874)
Do you currently follow a specific diet?	38	7.11 (2.024)	37	7.38 (1.754)	0.804**	<0.001	0.795** (.636, .889)
When you found out you were	31	2.68 (1.661)	31	2.58 (1.523)	0.482	0.007	0.481 (.151, .714)

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
pregnant did you change your eating habits (either for the better or worse)?							
Did your eating habits change for better or worse?	12	3.33 (1.557)	11	3.55 (1.508)	0.489	0.006	0.486 (.158, .717)
How much more/less did you eat during your first trimester of pregnancy?	32	3.56 (1.014)	31	3.39 (1.174)	0.692*	<0.001	0.690* (.444, .840)
How much did you eat during your second trimester of pregnancy?	32	3.03 (1.121)	31	3.00 (1.211)	0.565*	0.001	0.565* (.263, .766)
How much did you eat during your third trimester of pregnancy?	32	3.50 (.984)	31	3.61 (.715)	0.643*	<0.001	0.609* (.324, .793)
Where did you find out about any pregnancy related calorie (kcal) change information?	32	4.41 (1.932)	31	4.23 (2.045)	0.170	0.369	0.170 (-.197, .495)
How often have you been weighed by your health care provider during this pregnancy?	11	1.00 (0)	10	1.00 (0)	0.891**	<0.001	0.887** (.768, .947)
How often did your health care provider talk to you about weight gain and weight gain limits? (Please account for advice given during your past pregnancy only).	18	3.06 (1.514)	16	2.94 (1.569)	0.436	0.105	0.435 (-.079, .767)
Health practices / plans (21)							
Why are you currently not taking a prenatal vitamin?	2	3.50 (3.536)	2	3.50 (3.536)	1.000**		1.000***

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
If the choice was available, in what type of center would you want to give birth?	12	2.50 (0.674)	11	2.64 (0.674)	0.824**	0.002	0.824**(.471, .949)
How much more/less are you eating (compared to usual pre-pregnancy amount) during your pregnancy?	12	4.00(0.739)	11	3.91 (0.701)	0.417	0.202	0.361(-.271, .776)
Have you consumed any alcoholic beverages at any point during this pregnancy?	12	6.58 (0.900)	11	6.36 (1.206)	0.871**	<0.001	0.844**
Have you smoked cigarettes at any point during this pregnancy?	12	7.00 (0)	11	7.00 (0)	.	<0.001	.
Comparing your current weight to your weight 1 year pre-pregnancy, how has your weight changed? Do you weigh:	20	2.15 (1.814)	18	2.89 (2.111)	0.256	0.378	0.254(-.299, .679)
How often do you participate in high intensity workouts per week (heart beating rapidly; e.g., running, jogging, hard swimming or hard cycling)? (During this pregnancy).	12	2.33 (1.875)	10	2.60 (1.578)	0.615*	<0.001	0.915***(.717, .976)
Additional past pregnancy health practice questions							
In what type of centre did you give birth?	38	1.61 (0.679)	37	1.57 (0.647)	0.721*	<0.001	0.720*(.519, .845)
What was the method of delivery? (C-	32	2.84 (0.515)	31	2.84 (0.523)	1.000**	<0.001	1.000***

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
section, vaginal, VBAC)							
Did you smoke cigarettes at any point during pregnancy?	32	6.63 (0.660)	31	6.42 (1.232)	0.852**	<0.001	0.712*(.478, .852)
How long after birth did you begin breastfeeding?	32	6.81 (1.061)	31	6.84 (0.898)	1.000**	<0.001	0.984***(.966, .992)
What was your child fed after birth?	32	1.84 (1.221)	31	1.84 (1.214)	0.957**	<0.001	0.956***(.910, .979)
How many months did you exclusively breastfeed (number of months)?	32	1.22 (.553)	31	1.32 (0.702)	0.771*	<0.001	0.766**(.565, .881)
How many months did you exclusively formula feed (number of months before introduction of other foods)?	32	4.94 (3.212)	30	5.40 (3.081)	0.935**	<0.001	0.934***(.864, .968)
How often did you participate in medium intensity workout(s) per week (not exhausting; e.g., fast walking, easy cycling or dancing)?	32	.78 (1.184)	31	.61 (1.022)	0.646*	<0.001	0.612*(.328, .794)
How often did you participate in high intensity workout(s) per week (heart beating rapidly; e.g., running, jogging, hard swimming or hard cycling)?	32	3.00 (1.867)	31	2.97(1.741)	0.832**	<0.001	0.829**(.671, .915)
How many times per week did you exercise during your pregnancy? This includes any type of physical activity.	32	1.41 (0.798)	31	1.45 (0.810)	0.975**	<0.001	0.974***(.945, .987)
How often did you participate in low intensity workout(s) per week (minimal effort; e.g., easy walking,	31	1.58 (1.544)	31	1.71 (1.596)	0.766*	<0.001	0.765**(.559, .882)

Table 113: Test Retest Bivariate Correlations for All Constructs							
Construct name (number of items analyzed in construct) and listed items	N Test	$\bar{x}$ (SD) Test	N Retest	$\bar{x}$ (SD) Retest	Pearson Correlation (r value)	P Value (sig 1-tailed)	Test re-test reliability ICC (95% CI)
yoga or golf)?							
During a typical 7-Day period (one week), how often do you engage in regular activity that is long enough to work up a sweat (heart beats rapidly)?	37	2.97 (1.213)	37	3.08 (1.256)	0.869**	0.002	0.868**(.523, .969)
If yes, how long did it take to return to your pre-pregnancy weight?	25	1.36 (0.490)	23	1.43 (0.590)	0.535*	0.001	0.532*(.256, .728)
If no, Are you satisfied with your current postpartum weight?	10	2.40 (0.843)	12	2.25 (0.754)	0.708*	<0.001	0.696*(.396, .861)

Chapter 8

FINAL DISCUSSION AND CONCLUSIONS

Recent reviews and studies have demonstrated that women are continuing to gain more than the recommended weight targets while pregnant [26, 49, 55, 137, 139, 161-165]. Some have attributed this to all or one of the following: social factors, environmental factors, lack of weight gain guideline knowledge and/ or pre-pregnancy weight status.

The projects in this thesis have contributed to the body of knowledge around GWG and maternal health as well as paved the way for future research using the developed *EMat Health Questionnaire* to collect information from women about their current and/or past pregnancy experiences, and knowledge and thoughts on the current GWG guidelines.

8.1 Summary of thesis work and findings

This thesis aimed to examine the relationship between women's knowledge, behaviours and dietary patterns that contribute to excess weight gain in pregnancy. Originally, we analyzed MOM trial intervention and control participants to assess the success of the dietary component of the intervention. We realize that instituting diet change is challenging, and despite our efforts, women randomized to the intervention did not report positive changes in their macronutrient diet intake. Although 7-day diet records are commonly used and allow for comparisons to be made between studies, the reliability of this method has been challenged in recent literature [166, 167]. At the time of study development, 7-day records were considered the "gold standard" for self-report dietary data as it does not rely on respondents' memory and is open-ended. After further analysis on this data collection tool, it was found that the time consuming nature of 7-day records

(for the participants as well as data entry for the researchers) may lead to under reporting and data entry errors; thus, the reliability of its use has been questioned [167]. New technologies can improve experience and ease the time commitment required from participants, as well as allow for easy data upload to reduce the chance of entry error [168, 169]. Our group is currently working on a project to implement a phone application ("app") that will use 'new-age' technology in pregnancy.

Following the initial MOM trial findings, two study-based manuscripts were developed to provide a comprehensive understanding of maternal health and GWG. Data collected from the MOM trial outlined in *Manuscript 1* examined macronutrient dietary patterns of pregnant women from the Maternal Obesity Management (MOM) trial in the women who experienced excessive and non-excessive GWG based on the 2009, IOM guidelines. The findings showed a significant, decrease in the energy, protein and fat intake in the NEX group as well as a significant group-by-time interaction for energy and protein. These findings lead us to speculate that these dietary components may play a crucial role in weight management during pregnancy; future research is warranted on optimal dietary distributions for GWG management. As discussed, the limitations of using self-report diet data still exist, although the findings from this secondary analysis can lead us to attribute total energy intake and protein as a possible contributors of pregnancy-related weight management within our study.

Moving forward from the MOM trial findings, we recognized that a new and relevant tool was needed to assess women's (either currently pregnant or have recently given birth) knowledge and perception of the current weight gain guidelines, as well as other barriers to achieving optimal health throughout pregnancy.

Tools currently available and used in research are out of date and use inappropriate language (i.e., use the term fat instead of overweight/ obese). The previously validated *Pregnancy and Weight Gain Attitude Scale (PWGAS)* [170], which focuses on weight-related attitudes and behaviours during pregnancy (where low scores represent a negative attitude toward weight gain in pregnancy, and high scores represent a positive attitude), is antiquated as it is anchored using the 1990 IOM GWG guidelines and thus requires revising. In the *EMat Health Survey*, we have included questions relevant to today's contextual landscape, and also include adaptations of questions from *The Pregnancy Experience Scale (PES)* [171]. PES is a 41-item scale that measures pregnancy-specific daily hassles and provides the most balanced assessment of stress during pregnancy. Because there are many important and interwoven factors that contribute to healthy pregnancy weight gain, a questionnaire that incorporates all aspects related to GWG was needed.

This led us to the final paper; *Manuscript 2* outlined the development and validation of the *EMat Health Questionnaire*. This electronically administered questionnaire was developed to fill gaps in maternal health and address women's concerns, beliefs and behaviours on GWG. Unlike any other maternal health questionnaire (focusing on GWG) currently available; the comprehensive questionnaire is able to gather information regarding beliefs, behaviours, perception and motivation concerning diet, physical activity, weight gain and overall health of mother and fetus/child.

The preliminary validation illustrated that the questionnaire has good test re-test reliability for most constructs and we have confirmed content validity (via expert panel). The results of the pilot test and validation study suggested a few changes needed to be made to the questionnaire for clarity and simplicity. We have since modified the questionnaire according to

our preliminary findings (combining questions to shorten questionnaire, rewording for simplicity, and removing all “please describe answer options”). As validation is an on-going process, future studies using this questionnaire should obtain additional validation in order to strengthen the reliability of their research.

8.2 Current ongoing study update

The REDCap administered *EMat Health questionnaire* is currently being used in a global study to address maternal health concerns and to gain further validation. A few months ago (June, 2015), we obtained REB approval for and started data collection for a larger study using this newly developed questionnaire. To date, the questionnaire has reached over 1,000 women, with 918 consenting to participate (n=2 did not consent), 637 questionnaires are fully complete (n=281 partially complete). Of the 637 complete, 405 report on past pregnancies and 228 are currently pregnant (n=47 being first time moms) and n=4 did not report, but went on to complete the questionnaire. The questionnaire has reached women around the world, with participants from Australia, Bermuda, Brazil, England, Finland, France, Germany, Ireland, Israel, Kenya, Morocco, South Africa and the United Kingdom participating thus far. Further analysis of the data collected from the full study this winter, or once we collect at least 1000 completed surveys.

8.3 Proposed next steps

Overall, maternal obesity and pregnancy weight management are considered important research areas in need of attention and intervention. The findings of the two studies have improved the understanding of the complex relationships between diet, PA and GWG. With the development of a tool that will be used to assess women’s knowledge and behaviours surrounding health and weight gain during pregnancy. We hope that the *EMat Health Questionnaire* will continue to be used in future studies to glean useful data on relationships

between various SDH and GWG as well as associated health behaviours. The questionnaire can also be adapted and specific sections may be validated for use in a clinical setting to aid in the provision of useful information that can assist health care providers in supporting appropriate weight gain in pregnant patients.

As there are many key and interrelated factors that contribute to healthy pregnancy weight gain, further exploration of maternal health behaviours and appropriate weight gain is vital. The developments and findings from this thesis have added to the current literature and have set the stage for further studies on maternal diet, GWG and SDH related contributors (with one currently in progress using the developed questionnaire). Future research can lead to improved interventions for weight management during pregnancy ultimately help to facilitate healthy pregnancies and downstream maternal and child health.

Appendix 1 -RESEARCH ETHICS BOARD DOCUMENTATION

MATERNAL HEALTH QUESTIONNAIRE CHEO REB - INITIAL APPLICATION

CHEO Research Ethics Board Approval - Delegated Review

Principal Investigator: Dr. Kristi Adamo

REB Protocol No: 14/183X

Romeo File No: 20140503

Project Title: CHEOREB# 14/183X - Women's Perceptions of the Current Weight Gain Guidelines during Pregnancy

Primary Affiliation: HALO\HALO

Protocol Status: Active

Approval Date: January 09, 2015

Valid Until: December 15, 2015

Annual Renewal Submission Deadline: November 15, 2015

Documents Reviewed & Approved:

Document Name	Comments	Version Date
Recruitment Materials	Recruitment flyer Clean	submitted 2015/01/06
Other Document	List of references corresponding to Protocol document.	2014/10/17
Protocol	Maternal ESurvey version 8	2015/01/05
Questionnaire/Survey	Women's Health Perception Survey	2015/01/05
Consent Form	Consent form	2015/01/05

This is to notify you that the Children's Hospital of Eastern Ontario Research Ethics Board has granted approval to the above named research study on the date noted above. Your project was reviewed under the delegated review stream, which is reserved for projects that involve no more than minimal risk to human subjects.

Final approval is granted for the above noted study, with the understanding that the investigator agrees to comply with the following requirements:

1. The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board.
2. The investigator must not implement any deviation from, or changes to, the protocol without the approval of the REB, or when the change involves only logistical or administrative aspects of the study (e.g., change of telephone number or research staff).
3. The investigator must, prior to use, submit to the Board changes to the study documentation, e.g., changes to the informed consent letters, recruitment materials.
4. For all other research studies, investigators must promptly report to the REB all unexpected and untoward occurrences (including the loss or theft of study data and other such privacy breaches).
5. Investigators must submit an annual renewal report to the REB 30 days prior to the expiration date stated above.
6. Investigators must submit a final report at the conclusion of the study.

7. Investigators must provide the Board with French versions of the consent form, unless a waiver has been granted.

For complete procedures relating to REB procedures, please refer to the REB website at <http://www.cheori.org/en/researchethicsboard> or contact Natalie Anderson at nanderson@cheo.on.ca or 613-737-7600 ext. 3350.

Regards,

Dr. Carole Gentile

Chair, Research Ethics Board

Présidente, Comité d'éthique de la recherche

401 Smyth Road, Ottawa, ON K1H 8L1

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MATERNAL HEALTH QUESTIONNAIRE CHEO REB - FIRST AMENDMENT



RESEARCH INSTITUTE
INSTITUT DE RECHERCHE

CHEO Research Ethics Board

Approval - Minor Modification

Principal Investigator: Dr. Kristi Adamo

REB Protocol No: 14/183X

Romeo File No: 20140503

Project Title: CHEOREB# 14/183X - Women's Perceptions of the Current Weight Gain Guidelines during Pregnancy

Primary Affiliation: HALO\HALO

Protocol Status: Active

Date Modifications Approved: February 18, 2015

Documents Reviewed & Approved:

Document Name	Comments	Version Date
Other Document	REB Letter	2015/02/13
Questionnaire/Survey	Questionnaire	2015/02/13
Consent Form	Consent form	2015/02/13

This is to notify you that the Children's Hospital of Eastern Ontario Research Ethics Board has granted approval for the modifications to the above named research study. The minor modification was reviewed and approved by the Chair, and would be ratified by the full Board at its subsequent meeting.

In fulfilling its mandate, the CHEO REB is guided by: Tri-Council Policy Statement (TCPS); ICH Good Clinical Practice Practices: Consolidated Guideline; Applicable laws and regulations of Ontario and Canada (e.g., Health Canada Division 5 of the Food and Drug Regulations & the Food and Drugs Act - Medical Devices Regulations).

Approval is granted with the understanding that the investigator agrees to comply with the following requirements:

The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board.

The investigator must not implement any deviation from, or changes to, the protocol without the approval of the REB except where necessary to eliminate an immediate hazard to the research subject, or when the change involves only logistical or administrative aspects of the study (e.g., change of telephone number or research staff). As soon as possible, however, the implemented deviation or change, the reasons for it, and, if appropriate, the proposed protocol amendment(s) should be submitted to the Board for review.

The investigator must, prior to use, submit to the Board changes to the study documentation, e.g., changes to the informed consent letters, recruitment materials.

For clinical drug or device trials, investigators must promptly report to the REB all adverse events that are both serious and unexpected (SAEs). For SAE reports on CHEO patients, the investigator must also comply with the hospital-wide Policy regarding, Procedures For Considering Medical Error In The Differential Diagnosis of Severe Adverse Events (SAE) Associated with the Drugs Administered in a Clinical Trial

(see http://cheonet/data/1/rec_docs/3792_Medical%20Error%20Policy%20revised%20january%2020061.doc).

For all other research studies, investigators must promptly report to the REB all unexpected and untoward occurrences (including the loss or theft of study data and other such privacy breaches).

Investigators must promptly report to the REB any new information regarding the safety of research subjects (e.g., changes to the product monograph or investigator's brochure for drug trials). Where available, any reports produced by Data Safety Monitoring Board should be submitted to the REB.

Investigators must notify the REB of any study closures (temporary, premature or permanent), in writing along with an explanation of the rationale for such action.

Investigators must submit an annual renewal report to the REB 30 days prior to the expiration date stated on the final approval letter.

Investigators must submit a final report at the conclusion of the study.

Investigators must provide the Board with French version of the consent form, unless a waiver has been granted.

The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board. If you have any questions, pertaining to this letter, please contact Natalie Anderson, Research Ethics Board office at (613) 737-7600, ext. 3350 or nanderson@cheo.on.ca .

Regards,

Dr. Carole Gentile

Chair, Research Ethics Board

Présidente, Comité d'éthique de la recherche

401 Smyth Road, Ottawa, ON K1H 8L1

Tel: (613) 737-7600 ext. 3624 | Fax/Téléc: (613) 738-4202 |

MATERNAL HEALTH QUESTIONNAIRE CHEO REB - SECOND AMENDMENT



RESEARCH INSTITUTE
INSTITUT DE RECHERCHE

CHEO Research Ethics Board Approval - Minor Modification

Principal Investigator: Dr. Kristi Adamo

REB Protocol No: 14/183X

Romeo File No: 20140503

Project Title: CHEOREB# 14/183X - Women's Perceptions of the Current Weight Gain Guidelines during Pregnancy

Primary Affiliation: HALO\HALO

Protocol Status: Active

Date Modifications Approved: May 29, 2015

Documents Reviewed & Approved:

Document Name	Comments	Version Date
Questionnaire/Survey	Questionnaire	2015/05/27
Consent Form	Consent	2015/05/27

This is to notify you that the Children's Hospital of Eastern Ontario Research Ethics Board has granted approval for the modifications to the above named research study. The minor modification was reviewed and approved by the Chair, and would be ratified by the full Board at its subsequent meeting.

In fulfilling its mandate, the CHEO REB is guided by: Tri-Council Policy Statement (TCPS); ICH Good Clinical Practice Practices: Consolidated Guideline; Applicable laws and regulations of Ontario and Canada (e.g., Health Canada Division 5 of the Food and Drug Regulations & the Food and Drugs Act - Medical Devices Regulations).

Approval is granted with the understanding that the investigator agrees to comply with the following requirements:

1. The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board.

2. The investigator must not implement any deviation from, or changes to, the protocol without the approval of the REB except where necessary to eliminate an immediate hazard to the research subject, or when the change involves only logistical or administrative aspects of the study (e.g., change of telephone number or research staff). As soon as possible, however, the implemented deviation or change, the reasons for it, and, if appropriate, the proposed protocol amendment(s) should be submitted to the Board for review.
3. The investigator must, prior to use, submit to the Board changes to the study documentation, e.g., changes to the informed consent letters, recruitment materials.
4. For clinical drug or device trials, investigators must promptly report to the REB all adverse events that are both serious and unexpected (SAEs). For SAE reports on CHEO patients, the investigator must also comply with the hospital-wide Policy regarding, Procedures For Considering Medical Error In The Differential Diagnosis of Severe Adverse Events (SAE) Associated with the Drugs Administered in a Clinical Trial (see http://cheonet/data/1/rec_docs/3792_Medical%20Error%20Policy%20revised%20january%2020061.doc).
5. For all other research studies, investigators must promptly report to the REB all unexpected and untoward occurrences (including the loss or theft of study data and other such privacy breaches).
6. Investigators must promptly report to the REB any new information regarding the safety of research subjects (e.g., changes to the product monograph or investigator's brochure for drug trials). Where available, any reports produced by Data Safety Monitoring Board should be submitted to the REB.
7. Investigators must notify the REB of any study closures (temporary, premature or permanent), in writing along with an explanation of the rationale for such action.
8. Investigators must submit an annual renewal report to the REB 30 days prior to the expiration date stated on the final approval letter.
9. Investigators must submit a final report at the conclusion of the study.
10. Investigators must provide the Board with French version of the consent form, unless a waiver has been granted.

The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board.

If you have any questions, pertaining to this letter, please contact Natalie Anderson, Research Ethics Board office at (613) 737-7600, ext. 3350 or nanderson@cheo.on.ca.

Regards,

Dr. Carole Gentile

Chair, Research Ethics Board

Présidente, Comité d'éthique de la recherche

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MATERNAL HEALTH QUESTIONNAIRE CHEO REB - APPROVAL FOR WAIVER OF FRENCH TRANSLATION



RESEARCH INSTITUTE
INSTITUT DE RECHERCHE

Research Ethics Board
Approval for Waiver of French Translation

June 04, 2015

Principal Investigator: Dr. Kristi Adamo

REB Protocol No: 14/183X

ROMEO File No: 20140503

Project Title: CHEOREB# 14/183X - Women's Perceptions of the Current Weight Gain Guidelines during Pregnancy

Protocol Status: Active

Dear Dr. Adamo,

The CHEO Research Ethics Board has approved the request for a waiver of French translation.

Documents Reviewed:

Document Name	Comments	Version Date
Other Document	Request for waiver of French consent	2015/06/03

If you have any questions, pertaining to this letter, please contact Natalie Anderson, Executive Assistant, Research Ethics Board office at (613) 737-7600, ext. 3350 or nanderson@cheo.on.ca.

Regards,

Dr. Carole Gentile

Chair, Research Ethics Board

Présidente, Comité de la recherche

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MATERNAL HEALTH QUESTIONNAIRE UOTTAWA REB



Université d'Ottawa University of Ottawa

Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

June 30, 2015

Kristi Adamo
Department of Health Sciences
The University of Ottawa
kadamo@cheo.on.ca

Co-investigators: Holly Ockenden, University of Ottawa, Department of Health Sciences.

Re: U of O Ethics File no. A06-15-02 – “Women's Perceptions of the Current Weight Gain Guidelines during Pregnancy”

Dear Dr. Adamo and Miss Ockenden,

Thank you for the protocol documents and Certificate of Approval from CHEO for your project named above.

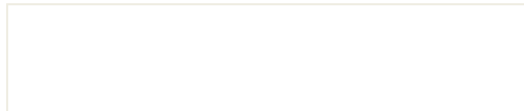
This is to confirm that, in accordance with the agreement between the University of Ottawa and the CHEO-REB, The University of Ottawa has authorized this board to act as Board of Record for the review and oversight of research involving human subjects conducted at or through the hospital.

We remind you of your obligation to:

- Follow all procedures of the CHEO-REB including reporting and renewal procedures;
- Submit to the authority of the CHEO-REB and that you are subject to CHEO-REB requirements, including, without limitation, the requirement to modify or stop the research on demand of the CHEO-REB.

If you have any questions, please contact our ethics office at 562-5387.

Sincerely yours,



Catherine Paquet
Director
Office of Research Ethics and Integrity

Appendix 2

MOM Trial Diet Record

MOM trial 7-day Dietary Record example

Purpose: To determine your food consumption with the goal of obtaining an accurate profile of your usual eating habits.

Instructions:

- It is very important that you be as **specific** and **detailed** as possible in your **descriptions of foods** and **quantities consumed (ml, teaspoons, tablespoons, grams, ounces, etc...)**. To help you, questions to trigger your memory have been placed on the right hand side of the page for each meal and snack period.
- Give a detailed description of all foods e.g. if you have a sandwich, list all ingredients (butter/mayonnaise/mustard, lettuce, tomatoes, etc). Use one line per ingredient.
- For recipes, specify the **quantity** of each ingredient (e.g. shepherd pie, lasagna, salads); attach the recipe to this journal.
- Indicate **precisely the method** of preparation (e.g. raw, boiled, steamed, cooked in the microwave, pan-fried, fried in oil, smoked, grilled in a pan, grilled on the BBQ, stewed, poached, roasted...)
- Indicate precisely the temperature and cooking time, when available (eg, chicken breast, roasted in the oven at 425 ° F for 25 min; chicken breast cooked in the microwave at moderate intensity for 5 min).
- Indicate the type and amount of **fat added** (eg. 1 tsp. of olive oil, 2tbsp of non-hydrogenated margarine, 3g of butter) when preparing, cooking and consuming foods. Also indicate condiments added (1tbsp of jam, 2 tbsp of peanut butter, 1tsp.of dressing, 2 tsp. of mustard...).
- Cut out the **food's label** (nutrition information) whenever possible and include them to this journal.
- Indicate **Brand** of products, if possible (e.g. Kraft, Smuckers...).
- If you eat out, specify the name of the **restaurant**.
- We ask you to indicate **all food intake (including water, beverages and supplements i.e., vitamins, minerals, natural products, herbal products)** for seven days in the tables provided on the following pages. Write the foods and beverages as soon as possible after their consumption.

The more detailed your dietary recall is,

the more precise will be the profile of your eating habits.

If you have any questions, please do not hesitate to ask

Research Coordinator (613) 737-7600 x3271 Kristi Adamo (613) 737-7600 x4190

Is this a weekend? Yes No

MEAL	TIME	PLACE	NAME AND DESCRIPTION OF FOOD	QUANTITY	DID YOU REMEMBER THE FOLLOWING?
Breakfast	7h00	home	Bowl of Cereal:		• Juice? Brand, real juice, from concentrate or not, pulp or no pulp, dry mix, cocktail • Fruits? Size / weight, with skin or peeled (e.g. apple), with added sugar? (E.g. apple sauce...) • Bread? White, whole-wheat, multigrain, roasted or not • Condiments? Quantity and type: butter, peanut butter, jam (sweetened/not sweetened), cheese • Muffin? Size: small, medium, large, type: homemade or commercial, contents: fruits, nuts, • Eggs? Size, cooking method (fried boiled, scrambled, poached ...)
			Corn Flakes: Kellogs	1 cup	
			Milk 1%	½ cup	
			Colombian coffee	1 cup	
			White Sugar	5 ml	
			Milk 1%	10 ml	
Snack before lunch	11h00	Work	Silhouette Fat-free strawberry yogurt	125g	
Lunch	12h00	Work	Egg salad sandwich:	1	• Milk products? Milk, cheese, yogurt, cream and their % of fat • Sugar, cream and syrup added? Quantity and type: in coffee, cereals, on crepes,
			Dempsters 100% Whole wheat bread, not roasted “Country Harvest”	2 slices	
			Becel regular margarine	10 ml	
Afternoon	2pm	Work	Kraft light mayonnaise	1 tbsp	• Added fat for preparation,

snack					<u>cooking and consumption?</u> Quantity and type : butter, Margarine, or oil • <u>Cereal bars?</u> Brand, contents, coated /not coate
			Boiled eggs	2	
			Triscuits – original whole-grain	5	
			Low-fat cheddar cheese (12%)	1 oz	
Supper	6pm	Home	Romaine lettuce	1 cup	• <u>Soup?</u> homemade, canned, packaged • <u>Salad? Contents:</u> quantity of vegetables, cheese, croutons, grains and nuts (plain or roasted). • <u>Sandwich? Bread:</u> white, whole- wheat, multigrain, roasted or not?
			Kraft “French” calorie- wise salad dressing	1 tbsp	
			Chicken breast skinless, boneless, oven grilled at 350°F for 25 minutes	3 oz	
Evening snack	8pm	Home	Dare Cookies – strawberry filling	2	

Units of measurement

tsp tbsp oz (fluid) milliliters (ml) grams (g) milligrams (mg) oz (weight) slice each
whole

Appendix 3

EMat Health validation web posting for generic online recruitment

Are you pregnant or have a child born after May, 2009?

The Children's Hospital of Eastern Ontario (CHEO) is seeking volunteers to take part in an online health survey to aid in the development of a tool to evaluate certain health perceptions and behaviours during pregnancy.

If you are currently pregnant or have a child born after May 2009 and you're 18 years or older, you are eligible to participate!

As a participant you will be asked to complete 2 confidential 25-minute online questionnaires.

To learn more about the study and to take part please copy and paste the survey link below:

<https://redcap.cheori.org/surveys/?s=LevQiQ4tsf>

To learn more about the research we do, check out the Healthy Active Living and Obesity Research (HALO):

www.haloresearch.ca

The study has been approved by CHEO research ethics board and is being supervised by Dr. Kristi Adamo. For more information about the study contact Holly at 613-737-7600 x.3011 or email hockenden@cheo.on.ca

Thank you for your time.

Appendix 4: EMat Health Validation Recruitment Flyer



Are you pregnant or have a child born after May 2009?

We are looking for volunteers to take part in an **ONLINE HEALTH SURVEY** to help develop a tool that evaluates health certain perceptions during pregnancy

Healthy Active Living and Obesity (HALO)
Children's Hospital of Eastern Ontario (CHEO) – Research Institute

SELECTION CRITERIA:

- Currently pregnant and/or have a child born after May, 2009
- Single baby only (no twins, triplets etc.)
- Over the age of 18 yrs.

Please feel free pass on the link below to other women who may meet the selection criteria.



Please go to the Maternal Health E-Survey Link:

<https://redcap.cheori.org/surveys/?s=LevQiQ4tsf>

Or for more information go to: www.HaloResearch.ca

This study was approved by the Children's Hospital of Eastern Ontario Research Ethics Board

Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca	Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca	Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca	Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca	Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca	Maternal Health E-Survey Link: https://redcap.cheori.org/surveys/?s=LevQiQ4tsf For more information: www.HaloResearch.ca
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Appendix 5

EMat Health Validation Consent Form

Test Re-test validation study consent form

You have been contacted to take part in The EMat Health Survey: Pregnancy Attitudes and Behaviours in women.

This is a research project being conducted by The Children's Hospital of Eastern Ontario (CHEO), Healthy Active Living & Obesity Research Group (HALO). This is the preliminary stage of the study to assess the usefulness and clarity of this questionnaire. The purpose of this survey is to find out how women (who are currently pregnant or have been pregnant in the last 5 years) feel about important prenatal health indicators.

The study involves filling out an online survey that will take approximately 15-25 minutes to complete. We will then contact you again 2 weeks (14-days) after your original survey completion date. At this time you will be asked to complete the final survey that should take approximately 15-25 minutes to complete. *The final survey will be very similar to the original survey and some questions may seem repetitive.*

You will be asked to enter your email address to allow us to contact you for the second portion of the study. Any information you provide will remain strictly confidential and you will not be identifiable from your data. The results of this study will be used to clarify and improve the questionnaire for use in a nation-wide maternal health study. The ultimate goal of this survey is to gain information that could help improve the health and well-being of pregnant women, mothers, and infants in Canada and beyond.

Your participation is completely voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. You do not have to answer any question you do not wish to answer.

Confidentiality

All survey answers will be sent to a link at www.REDCap.cheori.org where confidentiality of the data will be protected by keeping it stored in a password protected electronic format. Your identity will remain confidential as all individual records and results will be analyzed and referred to by assigning a unique ID number code only, as required by law. No data that identifies participants will be presented on any of the

forms, program reports, or research papers. The results of this study will be used for scholarly purposes only and may be shared with CHEO and Ottawa University representatives.

Costs and Compensation

There is no cost for participating in this research study. Participants will not receive any financial compensation. The CHEO Research Ethics Board could have access to study information. If you have any questions about your participation requirements or content of this study, please contact Dr. Kristi Adamo at 613-737-7600, ext. 4190. If no one answers your call, please leave a message and we will get back to you. This study has been reviewed and approved by the CHEO Research Ethics Board. The CHEO Research Ethics Board is a committee of the hospital that includes individuals from different professional backgrounds. The Board reviews all human research that takes place at the hospital. Its goal is to ensure the protection of the rights and welfare of people participating in research. You may contact the Chair of the Research Ethics Board, Dr. Carole Gentile, for information regarding your rights in research studies at (613) 737-7600 ext. 3272, although this person cannot provide any health-related information about the study.

ELECTRONIC CONSENT:

Please select your choice below. Clicking on the "agree" button below indicates that:

- You have read and understand the information for participants taking part in this pregnancy health questionnaire.
- You understand that taking part in this study is voluntary, that you may withdraw from the study at any time.
- You know who to contact if you have any questions about the questionnaire.
- You are at least 18 years of age.

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

Disagree

Agree

The information we receive will be of great use in our research study. Thank you.

Appendix 6

EMat Health Questionnaire – Stage 2 Consent form

Full-study Consent form – Study currently on-going

Are you currently pregnant or have you given birth since May, 2009? If yes, you are eligible to take part in *The EMat Health Survey: Pregnancy Attitudes and Behaviours in women of childbearing age*.

This is a research project being conducted by The Children's Hospital of Eastern Ontario (CHEO), Healthy Active Living & Obesity Research Group (HALO). The purpose of this survey is to find out how women (who are currently pregnant or have been pregnant since May, 2009) feel about important prenatal health indicators.

The study involves filling out an online survey that will take approximately 15-25 minutes.

The ultimate goal of this survey is to gain information that could help improve the health and well-being of pregnant women, mothers, and infants in Canada and internationally. All information collected will be of interest to maternal and child health researchers, public health professionals, policy makers, women's groups, and professional organizations in the field of maternal and infant health.

Your participation is completely voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, that is okay. You do not have to answer any question you do not wish to answer.

Confidentiality

Your survey answers will be sent to a link at www.REDCap.cheori.org where data will be stored in a password protected electronic format. This questionnaire does NOT collect any identifying information. Therefore, your responses will remain anonymous. All individual records and results will be analyzed and referred to by assigning a unique ID number code only, as required by law. The results of this study will be used for scholarly purposes only and may be shared with the study team from CHEO and the University of Ottawa.

Costs and Compensation

There is no cost for participating in this research study. Participants will not receive any financial compensation. If you have any questions about your participation requirements or content of this study, please contact Dr. Kristi Adamo at 613-737-7600, ext. 4190. This study has been reviewed and approved by the CHEO Research Ethics Board. The CHEO Research Ethics Board is a committee of the hospital that includes individuals from different professional backgrounds. The Board reviews all human research that takes place at the hospital. Its goal is to ensure the protection of the rights and welfare of people participating in research. You may contact the Chair of the Research Ethics Board, Dr. Carole Gentile, for information regarding your rights in research studies at (613) 737-7600 ext. 3272, although this person cannot provide any health-related information about the study.

If you are happy to participate in this study please read and complete the electronic consent form:

ELECTRONIC CONSENT:

Please select your choice below. Clicking on the "agree" button below indicates that:

- You have read and understand the information for participants taking part in this pregnancy health questionnaire.
- You understand that taking part in this study is voluntary, that you may withdraw from the study at any time.
- You know who to contact if you have any questions about the questionnaire.
- You are at least 18 years of age.

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

Disagree

Agree

Appendix 7

Final EMat Health Questionnaire

EMat Health Questionnaire

#	Field Name and Branching Logic	Field Label <i>Field Note</i>	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
1	record_id	Record ID	text
2	consent	Full consent form here – Participant must click agree or disagree	radio, Required 1 Agree 2 Disagree
Inclusion /Exclusion Questions			
3	cntly_preg	Are you currently pregnant?	radio, Required 1 Yes 2 No
4	crtlypreg_gestwk Show the field ONLY if: [cntly_preg] = '1'	Please specify your current gestational week of pregnancy:	radio 1 Less than 24 weeks 2 25-29 3 30-33 4 34-37 5 38-41 6 More than 41 weeks
5	multi_ygest Show the field ONLY if: [cntly_preg] = '1'	Please specify the type of pregnancy:	radio 1 Single (1 fetus) 2 Twins (2 fetuses) 3 Triplets (3 fetuses) 4 More than 3 fetuses 5 Don't know
6	sex_chd Show the field ONLY if: [multi_ygest] = '1' and[cntly_preg] = '1'	What is the sex of the fetus?	radio 1 Male 2 Female 3 I don't know
7	plan_preg Show the field ONLY if: [cntly_preg] = '1'	Was this pregnancy planned?	radio 1 Yes, pregnancy occurred naturally 2 Yes, pregnancy occurred due to fertility treatment

			3 No, pregnancy was not planned 4 Prefer not to answer
8	dob_chd	Have you given birth after May 2009?	yesno, Required 1 Yes 0 No
9	past_pregdt_dt Show the field ONLY if: [dob_chd] = '1'	Please specify the month of your most recent past birth. <i>Choose month here</i>	dropdown, Identifier 1 Jan 2 Feb 3 Mar 4 Apr 5 May 6 Jun 7 Jul 8 Aug 9 Sept 10 Oct 11 Nov 12 Dec
10	past_pregdt_yr Show the field ONLY if: [dob_chd] = '1'	Please specify the year of your most recent past birth. <i>Choose year here</i>	dropdown 1 2009 2 2010 3 2011 4 2012 5 2013 6 2014 7 2015
11	childkg_lbs Show the field ONLY if: [dob_chd] = '1'	Would you like to report this child's birth weight in grams (g) or pounds (lbs) and ounces (oz)?	radio, Required 1 Grams (g) 2 Pounds (lbs) and ounces (oz) 3 I do not know my child's birth weight
12	ch1bthwt_kg Show the field ONLY if: [childkg_lbs] = '1'	What was your child's birth weight? Please enter the amount in grams (g) here. for Kilogram (Kg) / Grams (g) conversion: 3.5 Kg = 3500 g (kg multiplied by 1000 = g) <i>Please enter amount in grams (g) only e.g. 3500</i>	text (integer, Min: 0, Max: 10000)
13	ch1bthwt_lbs Show the field ONLY if: [childkg_lbs] = '2'	What was your child's birth weight? (lbs, oz). Please enter lbs here. <i>E.g. if 7 lbs 3 oz, enter the number 7 here and 3 below.</i>	text (integer, Min: 0, Max: 50)

14	ch1bthwt_lbs_oz Show the field ONLY if: [childkg_lbs] = '2'	What was your child's birth weight? (Lbs, oz). Please enter ounce amount here. <i>E.g. if 7 lbs 3 oz, enter the number 3 here and 7 above.</i>	text (integer, Min: 0, Max: 50)
15	childlen_cmin Show the field ONLY if: [dob_chd] = '1'	Would you like to report your child's length at birth in centimetres (cm) or inches (in)?	radio, Required 1 Centimetres (cm) 2 Inches (in) 3 I don't know my child's length at birth
16	ch1bthlg_in Show the field ONLY if: [childlen_cmin] = '2'	What was your child's length at birth? (in) <i>Please enter only the number</i>	text (integer, Min: 0, Max: 100)
17	ch1bthlg_cm Show the field ONLY if: [childlen_cmin] = '1'	What was your child's length at birth? (cm) <i>Please enter only the number</i>	text (integer, Min: 0, Max: 100)
18	multi_ygest_pastp Show the field ONLY if: [dob_chd] = '1'	Please specify what type of pregnancy this was: (i.e. how many babies were delivered?)	radio 1 Single (1 baby) 2 Twins (2 babies) 3 Triplets (3 babies) 4 More than 3 babies
19	week_gest_born Show the field ONLY if: [dob_chd] = '1'	What week gestation was your child born?	radio 1 Less than 24 weeks 5 25-29 6 30-33 7 34-37 8 38-41 9 41+
20	chid2_sex Show the field ONLY if: [multi_ygest_pastp] = '1'	What is the sex of the child? <i>*Intersex is a general term used for a variety of conditions in which a person is born with a reproductive or sexual anatomy that doesn't seem to fit the typical definitions of female or male.</i>	radio 1 Male 2 Female 3 Intersex* 4 Multiples
21	plan_preg_pastp Show the field ONLY if: [dob_chd] = '1'	Was this previous pregnancy planned?	radio 1 Yes, pregnancy occurred naturally 2 Yes, pregnancy occurred due to fertility treatment 3 No, pregnancy was not planned 4 Prefer not to answer
22	nubr_chldn Show the field ONLY if: [dob_chd] = '1'	How many children (please include living, biological children only) do you have under the age of 6	radio 0 0

		<i>If currently pregnant, please do not include current pregnancy</i>	1 1 2 2 3 3 4 4 5 5+
23	stop_nopreg_nochd Show the field ONLY if: [dob_chd] = '0' and[cntly_preg] = '2'	You have stated that you are not currently pregnant and have not given birth after May, 2009. We require women who are currently pregnant and/or have a child born after May, 2009 to participate in this research study. Please exit the survey. Thank you for your time. descriptive	
Demographic Questions			
24	age	Select your age group (years old)	radio 1 18-23 2 24-29 3 30-34 4 35-39 5 40-44 6 45-49 7 50+
25	ethnicity	Which ethnic group do you most closely associate yourself?	radio 1 White 2 Chinese 3 South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.) 4 Black 5 Filipino 6 Latin American 7 Southeast Asian (e.g., Vietnamese, Cambodian, Malaysian, Laotian, etc.) 8 Arab 9 West Asian (e.g., Iranian, Afghan, etc.) 10 Korean 11 Japanese 12 Aboriginal (e.g., First Nation, Métis, Inuit) 13 Other

			14 Prefer not to answer
26	marlstat	Please select your current marital status	radio 1 Single 2 In a relationship but not living together 3 Common law 4 Married 5 Separated 6 Divorced 7 Widowed 8 Other 9 Prefer not to answer
27	edu	Please identify your highest level of education obtained	radio 1 Less than High School 2 High School/ GED 3 Some Post-Secondary Education 4 Trade Certification or Diploma (Vocational or Apprenticeship) 5 Non-University Certificate or Diploma (Community College, CEGEP) 6 Bachelor Degree (BA, BSc etc.) 7 Graduate degree (MD, JD, Masters, PhD etc.)
28	emplt	What is your current employment status? <i>If applicable, choose more than one</i>	radio 1 Self-employed 2 Employed 3 Student 4 Currently unemployed 5 Other 6 Prefer not to answer
29	income	What is your approximate annual household income?	radio 1 Less than \$30,000 2 \$30,000 - \$60,000 3 \$60,000 - \$90,000 4 \$90,000 - \$120,000 6 \$120,000 - \$150,000 7 \$150,000+ 8 Prefer not to answer
30	setng	Do you consider where you live to be <i>M = Million</i>	radio 1 Urban area (large city) (population >1M) 2 Suburban (smaller city or region outside

			an urban area) (population >10,000 to < 1M) 3 Rural area (population < 10,000)
31	ftin_cm	Would you like to report your current height in feet/inches (ft/in) or centimeters (cm)?	radio 1 feet (ft), Inches (in) 2 Centimeters (cm) 3 I would rather not report my current height 4 I do not know my current height
32	ht_cm Show the field ONLY if: [ftin_cm] = '2'	What is your current height in centimeters (cm)? <i>Please enter only the number</i>	text (integer, Min: 0, Max: 300)
33	ht_ft Show the field ONLY if: [ftin_cm] = '1'	What is your current height in feet (ft) and inches (in)? Please enter your height in feet (ft) here. E.g. If your height is 5 feet 8 inches, enter 5 here (and 8 in the field below) <i>Please enter only the number</i>	text (integer, Min: 3, Max: 9)
34	ht_in Show the field ONLY if: [ftin_cm] = '1'	You are entering your height in feet (ft) and inches (in). Please enter your corresponding inches (in) here. <i>Please enter only the number</i>	text (integer, Min: 0, Max: 11)
35	kg_lbs	Would like to report your weight in kilograms (kg) or pounds (lbs)?	radio, Required 1 Kilograms (kg) 2 Pounds (lbs) 3 I do not know my weight 4 Prefer not to answer
36	wt_kg Show the field ONLY if: [kg_lbs] = '1'	What is your current weight? (kg) <i>Please enter only the number</i>	text (integer, Min: 0, Max: 400)
37	wt_lbs Show the field ONLY if: [kg_lbs] = '2'	What is your current weight? (lbs) <i>Please enter only the number</i>	text (integer, Min: 0, Max: 400)
38	preprg_wtkg Show the field ONLY if: [kg_lbs] = '1' and[cntly_preg] = '1'	Just before your current pregnancy, how much did you weigh (kg)? Please report on the 6 months prior to this pregnancy. <i>Please enter only the number</i>	text (integer, Min: 0, Max: 400)
39	preprg_wtlbs Show the field ONLY if: [kg_lbs] = '2' and[cntly_preg] = '1'	Just before your current pregnancy, how much did you weigh (lbs)? Please report on the 6 months prior to this pregnancy.	text (integer, Min: 0, Max: 400)

		<i>Please enter only the number</i>	
40	wt_change Show the field ONLY if: [cntly_preg] = '1' or[kg_lbs] = '1' or[kg_lbs] = '2'	Did your pre-pregnancy weight often fluctuate more than 4.5 kg (10 lbs)?	yesno 1 Yes 0 No
41	pregy_chldy Show the field ONLY if: [cntly_preg] = '1' and[dob_chd] = '1'	You have reported that you are currently pregnant AND have a child born after May 2009. The first section of this questionnaire will ask about your CURRENT pregnancy. The second section of this questionnaire will ask about your most recent PAST pregnancy. descriptive	
42	currpreg_ok Show the field ONLY if: [cntly_preg] = '1'	You have reported that you are currently pregnant. The following questions ask about your current pregnancy	
	Current Pregnancy - Health Care Questions		
43	cnty_prenatcr2 Show the field ONLY if: [cntly_preg] = '1'	In what country do you receive most of your prenatal care?	radio 1 Canada 2 USA 3 Other
44	prenat_lctn Show the field ONLY if: [cnty_prenatcr2] = '1'	In what province or territory do you receive most of your prenatal care?	dropdown All provinces available for option
45	preanat_stat Show the field ONLY if: [cnty_prenatcr] = '2'	In what state do you receive most of your prenatal care?	dropdown All states available for option
46	other_cnty Show the field ONLY if: [cnty_prenatcr] = '3'	In what country do you received most of your prenatal care? <i>Please type country name</i>	text (alpha_only)
47	hlth_provid_currpreg Show the field ONLY if: [cntly_preg] = '1'	From which type of health care provider do you receive MOST of your prenatal care? Click multiple answers if applicable (e.g. your family doctor is also an OB/ GYN) <i>Choose multiple if applicable</i>	checkbox 1 Obstetrician/ Gynecologist (OB/GYN) 2 Family doctor 3 Midwife 5 Nurse/ nurse practitioner 6 Other
48	prepreg_wt_self Show the field ONLY if: [cntly_preg] = '1'	Thinking of your pre-pregnancy weight, what weight did you consider yourself?	radio 1 Underweight 2 Normal weight 3 Overweight

			4 Obese 5 I don't know 6 Prefer not to answer
49	preg_wt2 Show the field ONLY if: [cntly_preg] = '1'	How often have you been weighed by your health care provider during this pregnancy?	radio 1 Every visit 2 Every other visit 3 Once in a while 4 Only once 5 Never 6 Prefer not to answer
50	currpreg_wtlimit Show the field ONLY if: [cntly_preg] = '1'	Have they talked to you about your weight and/or your weight gain limits?	yesno 1 Yes 0 No
51	healthprov_wtgn Show the field ONLY if: [cntly_preg] = '1'	Did they give you an amount of weight gain you should aim for during this pregnancy?	radio 1 Yes 2 No 3 I don't know
52	gainamt_healprov_kg Show the field ONLY if: [cntly_preg] = '1' and[kg_lbs] = '1' and[currpreg_wtlimit] = '1' and[healthprov_wtgn] = '1'	What is the amount of weight gain advised by your health care provider (kg)? If you were given a range, provide the number in the middle (i.e. 25-35 would be 30). <i>Please enter amount in kg (type numbers with no spaces)</i>	text (integer, Min: 0, Max: 100)
53	gainamt_healprov_lbs Show the field ONLY if: [cntly_preg] = '1' and[kg_lbs] = '2' and[healthprov_wtgn]='1'	What is the amount of weight gain advised by your health care provider (lbs)? If you were given a range, provide the number in the middle (i.e. 25-35 would be 30). <i>Please enter amount in lbs (type numbers with no spaces)</i>	text (integer, Min: 0, Max: 100)
54	gwg_target Show the field ONLY if: [cntly_preg] = '1' and[healthprov_wtgn] = '1'	Do you think this weight gain amount is a realistic target for you?	radio 1 Yes 2 No 3 I don't know 4 Prefer not to answer
55	wtgainlim_eff2 Show the field ONLY if: [currpreg_wtlimit] = '1'	Do you make a conscious effort to stay within these weight gain limits?	radio 1 Never 2 Rarely 3 Sometimes 4 Most of the time 5 Always
56	wtgn_realynt		

	Show the field ONLY if: [gwg_target] = '2'	Why do you feel this is not a realistic target weight gain amount for you?	radio 1 I don't think it's enough weight to gain while pregnant 2 I don't want to have to worry about my weight while I'm pregnant 3 I have trouble limiting weight gain during pregnancy 4 I've already gained this much or more weight during my pregnancy 5 I don't know 6 Other
57	healthcarepro_advice Show the field ONLY if: [currpreg_wtlimit] = '1' and[healthprov_wtgn] = '2'	What was the weight gain advice or information from your health care provider? Information/ advice on: <i>Please check multiple if applicable</i>	checkbox 1 Weight gain recommendations during pregnancy 2 How weight/ weight gain may affect your baby 3 Exercising while pregnant 4 Diet changes during pregnancy 5 Other 6 I don't know
58	preg_wtgain_lmts Show the field ONLY if: [currpreg_wtlimit] = '1'	How often has your health care provider talked to you about weight gain? Please account for advice for your current pregnancy only.	radio 1 Every visit 2 Every other visit 3 Once in a while 4 Only once 5 Never 6 I don't know
59	wtganlimi_conf2 Show the field ONLY if: [wt_limit] = '1'	Do you feel confident about being able to stay within the weight gain limits advised to you by your health care provider?	radio 1 Never 2 Rarely 3 Sometimes 4 Most of the time 5 Always
60	wtganlimi_conf1_no Show the field ONLY if:	You answered "Never" or "Rarely" to feeling confident about being able to	checkbox

	[wtganlimi_conf2] = '1' or[wtganlimi_conf2] = '2'	stay within the weight guidelines suggested by your health care provider. Why do you feel this way? <i>feel free to choose multiple answers</i>	1 I don't have support from family 2 I don't have support from friends 3 I have always struggled with my own weight management 4 I don't worry about weight while I'm pregnant and therefore don't keep track of how much I gain 5 The advice from my health care provider was not useful in managing my weight 6 Other
61	wtganlimi_conf2_yes Show the field ONLY if: [wtganlimi_conf2] = '1' or[wtganlimi_conf2] = '2'	You answered "most of the time" or "always" to feeling confident about being able to stay within the weight guidelines suggested by your health care provider. Why do you feel this way? <i>feel free to choose multiple answers</i>	checkbox 1 I had / have support from family 2 I had / have support from friends 3 I have always felt confident in my own weight management

			4 I am a healthy person and I've always been able to maintain a healthy weight 5 The advice from my health care provider was useful in managing my weight 6 Other
62	underwt_wtgain0 Show the field ONLY if: [cntly_preg] = '1'	I would feel MOST comfortable gaining the following amount during my pregnancy:	radio 1 Less than 5 kg (11 lbs) 2 5-9 kg (11- 20 lbs) 3 7-11.5 kg (15-25 lbs) 4 11.5-16 kg (25-35 lbs) 5 12.5-18 kg (28-40 lbs) 6 More than 18 kg (40 lbs) 7 I don't know 8 Prefer not to answer
Current Pregnancy - Physical Activity Habits / Plans			
63	exerspln Show the field ONLY if: [cntly_preg] = '1'	Do you plan to exercise during this pregnancy?	yesno 1 Yes 0 No
64	curr_preg_ex Show the field ONLY if: [cntly_preg] = '1'	Have you exercised as much as you would like to during this pregnancy?	yesno 1 Yes 0 No
65	currpreg_noex Show the field ONLY if: [curr_preg_ex] = '0'	If no, why have you not exercised as much as you would like? <i>Please check multiple if applicable</i>	checkbox 1 Unsure of what to do (nervous) 2 Told not to exercise by health care professional (health concerns) 3 Too tired 4 Felt sick

			5 Too much pain/ discomfort 6 Lack of time 7 Lack of money 8 Difficulty obtaining childcare 9 No one to go with 10 No interest/ motivation 11 Too self-conscious 12 Lack of support from family/ friends 13 Illness 14 Other
66	currpreg_yesex Show the field ONLY if: [curr_preg_ex] = '1'	If yes, what do you believe has helped you exercise during this pregnancy? <i>feel free to choose multiple answers</i>	checkbox 1 I am an active person, so it was easy to continue 2 I felt fine while pregnant (no sickness or fatigue) 3 I had / have support from family 4 I had / have support from friends 5 I had the support of my employer 6 None of the above 7 Other
67	currpreg_intensity Show the field ONLY if: [cntly_preg] = '1'	How often do you participate in HIGH intensity workouts per week (heart beating rapidly; e.g., running, jogging, hard swimming or hard cycling)? (During this pregnancy). <i>per week</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+

68	currpreg_intensity2 Show the field ONLY if: [cntly_preg] = '1'	How often do you participate in MEDIUM intensity workouts per week (not exhausting; e.g., fast walking, easy cycling or dancing)? (During this pregnancy). <i>per week</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+
69	currpreg_intensity3 Show the field ONLY if: [cntly_preg] = '1'	How often do you participate in LOW intensity workout(s) per week (Minimal effort; e.g., yoga, golf, easy walking)? (During this pregnancy). <i>per week</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+
70	currpreg_activ Show the field ONLY if: [cntly_preg] = '1'	What type of activity/ activities do you participate in during your current pregnancy? <i>Please check multiple if applicable</i>	checkbox 0 None 1 Running/ jogging 2 Swimming 3 Fast cycling 4 Slow Cycling 5 Fast walking 6 Slow walking 7 Dancing 8 Yoga 9 Golf 10 Weight lifting 11 Aerobics classes 12 Water aerobics 13 Prenatal fitness classes? 14 Personal training sessions (low impact) 15 Personal training sessions (high impact) 16 I participate in other form(s) of low impact activity/ activities

			17 I participate in other form(s) of high impact activity/ activities
71	ex_motiv Show the field ONLY if: [cntly_preg] = '1'	What are your motivations for exercise? <i>feel free to choose multiple answers</i>	checkbox 1 Maintain / limit weight gain 2 Socialize 3 Competition 4 Release tension 5 Enhance mental health 6 Keep fit 7 For the health of my baby 8 For my health 9 Other
Current Pregnancy - Diet Habits / Plans			
72	diet_chang Show the field ONLY if: [cntly_preg] = '1'	Have your eating habits changed during this pregnancy? Example: Poor eating habits may include eating less healthy foods, skipping meals, late night snacking etc.	radio 1 My eating habits are less healthy 2 My eating habits have stayed the same 3 My eating habits are more healthy 4 I don't know
73	preg_foodamt Show the field ONLY if: [cntly_preg] = '1' and [diet_chang] = '1' or [diet_chang] = '3'	How much more/less are you eating (compared to usual pre-pregnancy amount) during your pregnancy? <i>Compared to usual pre-pregnancy diet</i>	radio 1 Much less 2 A little less 3 The same 4 A little more 5 Much more 6 I don't know 7 Prefer not to answer
74	preg_cfg Show the field ONLY if: [cntly_preg] = '1'	Are you following Canada's Food Guide while pregnant?	radio 1 Never 2 Rarely 3 Sometimes 4 Often

			5 All of the Time 6 I don't know Canada's Food Guide 7 I am aware of Canada's Food Guide, but not sure if I am following it
75	preg_natfg Show the field ONLY if: [cntly_preg] = '1' and[cnty_prenatcr2] = '3' and[cnty_prenatcr2] = '2'	Are you following your national food guide recommendations, if one exists?	radio 1 Never 2 Rarely 3 Sometimes 4 Often 5 All of the Time 6 There is no national food guide 7 I am aware of our national food guide, but not sure if I am following it
76	diet_changes_htlhcr Show the field ONLY if: [cntly_preg] = '1'	Has your health care provider ever discussed any necessary diet changes you should make during this pregnancy (calorie changes, vitamin requirements etc.)?	yesno 1 Yes 0 No
77	diet_hlthcr_advce Show the field ONLY if: [diet_changes_htlhcr] = '1'	What was the dietary advice given to you from your health care provider during this pregnancy? <i>feel free to choose multiple answers</i>	checkbox 1 Increase the amount of vegetables/ fruit 2 Decrease the amount of vegetables/ fruit 3 Increase the amount of fiber 4 Decrease the amount of fiber 5 Increase the amount of high fat foods 6 Decrease the amount of high fat foods 7 Prenatal vitamin advice

			8 Other
78	kcal_req_amt	Do you know how your personal calorie requirements change during pregnancy?	yesno 1 Yes 0 No
79	kcal_req_partrept Show the field ONLY if: [kcal_req_amt] = '1'	If yes, please specify the calorie (kcal) amount change (additional calories needed per day while pregnant). Please enter just the number. <i>additional kcal per day during pregnancy</i>	text (integer, Min: 0, Max: 2000)
80	preg_diet_advice	Did you receive advice from your family or friends about what or how much to eat while pregnant?	yesno 1 Yes 0 No
81	diet_advi	Whose advice do you trust the MOST (in regards to diet while pregnant)?	radio 1 Health care provider 2 Family members (parents, siblings) 3 Friends 4 Significant other/partner 5 Media/ information from the internet
82	alc_preg_currpreg Show the field ONLY if: [cntly_preg] = '1'	Have you consumed any alcoholic beverages at any point during this pregnancy?	radio 1 Every day 2 2-3 times a week 3 Once a week 4 Once every 2-3 wks 5 Once a month 6 On special occasions only 7 Never 8 Prefer not to answer
83	smok_preg_currpreg Show the field ONLY if: [cntly_preg] = '1'	Have you smoked cigarettes at any point during this pregnancy? <i>Do not include tobacco smoke during traditional ceremonies</i>	radio 1 Every day 2 2-3 times a week 3 Once a week 4 Once every 2-3 wks 5 Once a month 6 On special occasions only 7 Never 8 Prefer not to answer
84	prenat Show the field ONLY if: [cntly_preg] = '1'	Are you currently taking a prenatal vitamin?	radio 1 Yes

			2 No
85	prenat_no Show the field ONLY if: [prenat] = '2'	Why are you currently not taking a prenatal vitamin?	radio 1 Personal choice 2 Prenatal vitamins are too expensive 3 I don't know where to get them 4 I believe they are unnecessary 5 I didn't know it was needed 6 Other
86	birth_cntr_currpreg Show the field ONLY if: [cntly_preg] = '1'	If the choice was available, in what type of center would you want to give birth?	radio 1 Home 2 Birth centre 3 Hospital 4 Other 5 I don't know 6 Prefer not to answer
87	bstfd_currpreg Show the field ONLY if: [cntly_preg] = '1'	Do you plan to breastfeed your baby?	radio 1 Yes 2 No 3 Unsure 4 Prefer not to answer
88	no_brstfed Show the field ONLY if: [bstfd_currpreg] = '2' and[cntly_preg] = '1'	Why do you plan not to breastfeed your baby?	radio 1 I believe that formula is healthier for a baby 2 I have a medical condition that prevents me from breastfeeding 3 I want my partner to feed the baby 4 I don't know how to breastfeed 5 Other 6 Prefer not to answer
89	dob_chld_ok Show the field ONLY if: [dob_chd] = '1'	You have reported that you have a child born after May, 2009. Please answer the following questions with regards to your MOST RECENT PAST pregnancy (child born after May 2009).	
Past Pregnancy - Health Care			
90	cnty_prenatcr Show the field ONLY if: [dob_chd] = '1'	Where did you receive your prenatal care for your most recent past pregnancy?	radio 1 Canada 2 USA 3 Other
91	prenat_lctn2 Show the field ONLY if: [cnty_prenatcr] = '1'	In what province or territory did you receive most of your prenatal care?	dropdown All provinces and territories available
92	preanat_stat2	In what state did you receive most of	dropdown

	Show the field ONLY if: [cnty_prenatcr] = '2'	your prenatal care?	All US States available
93	other_cnty2 Show the field ONLY if: [cnty_prenatcr] = '3'	In what country did you received most of your prenatal care?	text
94	hlth_provid_currpreg2 Show the field ONLY if: [dob_chd] = '1'	From which type of health care provider did you receive MOST of your prenatal care for your past pregnancy? <i>Click multiple answers if applicable (e.g. your family doctor is also an OB/ GYN)</i>	checkbox 1 Obstetrician/ Gynecologist (OB/GYN) 2 Family doctor 3 Midwife 5 Nurse/ nurse practitioner 6 Other
95	prepreg_wt_self2 Show the field ONLY if: [dob_chd] = '1'	Before your past pregnancy, what weight did you consider yourself? <i>Before your most recent past pregnancy</i>	radio 1 Underweight 2 Normal weight 3 Overweight 4 Obese 5 I don't know 6 Prefer not to answer
96	preg_wt Show the field ONLY if: [dob_chd] = '1'	How often did your health care provider weigh you while pregnant?	radio 1 Every visit 2 Every other visit 3 Once in a while 4 Only once 5 Never 6 Prefer not to answer
97	wt_limit Show the field ONLY if: [dob_chd] = '1'	Did your doctor or health care provider talk to you about your weight and/ or weight gain limits during pregnancy?	yesno 1 Yes 0 No
98	preg_wt2_b49 Show the field ONLY if: [wt_limit] = '1'	How often did your health care provider talk to you about weight gain and weight gain limits? (Please account for advice given during your past pregnancy only).	radio 1 Every visit 2 Every other visit 3 Once in a while 4 Only once 5 Never 6 Prefer not to answer

99	wt_hcp Show the field ONLY if: [wt_limit] = '1'	Did your health care provider give you a specific weight gain amount or a weight gain range for your pregnancy? <i>Please refer to your most recent past pregnancy</i>	yesno 1 Yes 0 No
100	we_trgt_perso Show the field ONLY if: [wt_limit] = '0'	Since you were not advised about target amount of weight gain during pregnancy, did you have a personal target?	radio 1 Yes 2 No 3 Prefer not to answer
101	gainamt_healprov_lbs2 Show the field ONLY if: [we_trgt_perso] = '1' and[cntly_preg] = '1' and[kg_lbs] = '2'	What was the amount of weight gain advised by your health care provider (lbs)? If no advice was given, what was your personal weight gain target for pregnancy? <i>Please enter just the number (no spaces) in lbs</i>	text (integer, Min: 0, Max: 100)
102	gainamt_healprov_kg2 Show the field ONLY if: [cntly_preg] = '1' and[kg_lbs] = '1' and[currpreg_wtlimit] = '1' and[we_trgt_perso] = '1'	What was the amount of weight gain advised by your health care provider (kg)? If no advice was given, what was your personal weight gain target for pregnancy? <i>Please enter just the number (no spaces) in kg</i>	text (integer, Min: 0, Max: 100)
103	tgtwt_kg2 Show the field ONLY if: [dob_chd] = '1' and[kg_lbs] = '1'	What was your ACTUAL weight gain during pregnancy? Please enter in kilograms (kg) <i>kg</i>	text (integer, Min: 0, Max: 200)
104	tgtwt_lbs2_5f1 Show the field ONLY if: [dob_chd] = '1' and[kg_lbs] = '2'	What was your ACTUAL weight gain during pregnancy? Please enter in pounds (lbs) <i>lbs</i>	text (integer, Min: 0, Max: 200)
105	wtgainlim_eff Show the field ONLY if: [wt_limit] = '1'	Did you make a focused effort to stay within the weight gain limits given to you by your health care provider?	radio 1 Never 2 Rarely 3 Sometimes 4 Most of the time 5 Always
106	wtganlimi_conf Show the field ONLY if: [wt_limit] = '1'	Did you feel confident about being able to stay within the weight gain limits provided for your past pregnancy?	radio 1 Never 2 Rarely 3 Sometimes 4 Most of the time 5 Always
107	no_limitprov	If no weight gain limits or guidelines	radio

	Show the field ONLY if: [wt_hcp] = '1'	were provided to you, do you feel that if you had been guided in this area that you would have made an effort to stay within the limits?	1 Never 2 Rarely 3 Sometimes 4 Most of the time 5 Always
108	no_limits_why Show the field ONLY if: [no_limitprov] = '1' and '2'	You answered "Never" or "Rarely" to making an effort to staying within the weight gain limits given to you from your health care provider while pregnant. Why do you feel this way?	radio 1 Guidelines are too restrictive 2 Weight management is not a priority for me while pregnant 3 I follow weight gain advice from family instead 4 I follow weight gain advice from friends instead 5 Other
109	no_limits_why2 Show the field ONLY if: [no_limitprov] = '4' and '5'	You answered "Most of the time" or "Always" to making an effort to staying within the weight gain limits given to you from your health care provider while pregnant. Why do you feel this way?	radio 1 Guidelines are reasonable expectations 2 Weight management was a priority for me 3 Other
110	wtgain_1yrpre Show the field ONLY if: [dob_chd] = '1'	Comparing your current weight to your weight 1 year pre-pregnancy, how has your weight changed? <i>Please refer to your past pregnancy</i>	radio 1 I weight more than I did 1 year pre-pregnancy 2 I weigh the same as I did 1 year pre-pregnancy 3 I weigh less than I did 1 year pre-pregnancy
111	wtgain_1yrpre_more Show the field ONLY if: [wtgain_1yrpre] = '1' and [kg_lbs] = '1'	You have selected that you currently weight more than you did 1 year pre-pregnancy. Please specify the weight change amount:	radio 1 less than 5 lbs (< 2 kg) 2 6 -10 (3 -4.5 kg) 3 11-15 (4.5 -7 kg) 4 16-20 (7-9 kg) 5 21-25 (9-11.5 kg) 6 26-30 (11.5-13.5 kg) 7 more than 30 lbs (>13.5 kg)
112	wtgain_1yrpre_less Show the field ONLY if: [wtgain_1yrpre] = '1' and [kg_lbs] = '1'	You have selected that you currently weight less than you did 1 year pre-pregnancy. Please specify the weight change amount:	radio 1 less than 5 lbs (< 2 kg) 2 6 -10 (3 -4.5 kg) 3 11-15 (4.5 -7 kg) 4 16-20 (7-9 kg) 5 21-25 (9-11.5 kg) 6 26-30 (11.5-13.5 kg) 7 more than 30 lbs (>13.5 kg)

113	se_add Show the field ONLY if: [dob_chd] = '1'	Have you been able to lose the weight you gained from your most recent previous pregnancy in order to get back to your pre-pregnancy weight?	yesno 1 Yes 0 No
114	se_add1 Show the field ONLY if: [se_add] = '1'	If yes, how long did it take to return to your pre-pregnancy weight?	radio 1 0-6 months 2 7-12 months 3 13-24 months 4 More than 24 months
115	se_add3 Show the field ONLY if: [se_add] = '0'	If no, are you satisfied with your current postpartum weight?	radio 1 Yes 2 No 3 Don't know 4 Prefer not to answer.
116	se_add4 Show the field ONLY if: [se_add3] = '2'	If you are NOT satisfied with your postpartum weight, do you feel that other women feel the same after they give birth?	radio 1 Yes 2 No 3 Don't know 4 Prefer not to answer
117	se_add5 Show the field ONLY if: [dob_chd] = '1'	Do you consider feelings of weight dissatisfaction after pregnancy normal within your social network?	radio 1 Yes 2 No 3 Don't know 4 Prefer not to answer
Past Pregnancy - Physical Activity			
118	exerspln_pst Show the field ONLY if: [dob_chd] = '1'	Did you plan to exercise during this pregnancy?	yesno 1 Yes 0 No
119	pstpreg_ex Show the field ONLY if: [dob_chd] = '1'	Did you exercise as much as you would have liked during your most recent past pregnancy?	yesno 1 Yes 0 No
120	noex_why Show the field ONLY if: [pstpreg_ex] = '0' and[dob_chd] = '1'	If no, why did you not exercise as much as would have liked? <i>Feel free to choose multiple answers</i>	checkbox 1 Unsure of what to do (nervous) 2 Told not to exercise by a health care professional (health concerns)

			3 Too tired 4 Felt sick 5 Too much pain/ discomfort 6 Lack of time 7 Lack of money 8 Difficulty obtaining childcare 9 No one to go with 10 No interest/ motivation 11 Too self-conscious 12 lack of support from family/ friends 13 Illness 14 Other
121	yex_why2 Show the field ONLY if: [pstpreg_ex] = '1' and[dob_chd] = '1'	If yes, what do you believe helped you exercise during pregnancy? <i>Feel free to choose multiple answers</i>	checkbox 15 I am an active person, so it was easy to continue 16 I felt fine while pregnant (no sickness or fatigue) 17 I had / have support from family 18 I had / have support from friends 19 I had the support of my employer 20 None of the above 21 Other
122	hlthprob_preg Show the field ONLY if: [dob_chd] = '1'	Were you diagnosed with any health problems (pregnancy-related or non-pregnancy related) which may have affected your participation in exercise?	radio 1 No, health issues 2 Yes, non-pregnancy related health issue(s) 3 Yes, pregnancy related health issue(s) 4 Yes, pregnancy and non-pregnancy related health issues
123	ex_pwk Show the field ONLY if: [dob_chd] = '1'	How many times per week did you exercise during your pregnancy? This includes any type of physical activity. <i>per week</i>	dropdown 0 0 1 1 2 2

			3 3 4 4 5 5+
124	ex_pwk_high Show the field ONLY if: [dob_chd] = '1'	How often did you participate in HIGH intensity workout(s) per week (heart beating rapidly; e.g., running, jogging, hard swimming or hard cycling)? <i>per week, during your past pregnancy</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+
125	ex_pwk_med Show the field ONLY if: [dob_chd] = '1'	How often did you participate in MEDIUM intensity workout(s) per week (not exhausting; e.g., fast walking, easy cycling or dancing)? <i>per week, during your past pregnancy</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+
126	ex_pwk_low Show the field ONLY if: [dob_chd] = '1'	How often did you participate in LOW intensity workout(s) per week (minimal effort; e.g., easy walking, yoga or golf)? <i>per week, during your past pregnancy</i>	dropdown 0 0 1 1 2 2 3 3 4 4 5 5+
127	activ_preg Show the field ONLY if: [dob_chd] = '1'	Did you participate in any of the following activity/activities while pregnant? <i>Please check multiple if applicable</i>	checkbox 1 Running/ jogging 2 Swimming 3 Fast cycling 4 Slow Cycling 5 Fast walking 6 Slow walking 7 Dancing 8 Yoga 9 Golf

			10 Weight lifting 11 Aerobics classes 12 Personal training sessions (low impact) 13 Personal training sessions (high impact) 14 Other forms of high impact activity/ activities 15 Other forms of low impact activity/ activities
128	activ_modiv Show the field ONLY if: [dob_chd] = '1'	What were your motivations for exercise? <i>Feel free to choose multiple answers</i>	checkbox 1 Maintain or limit weight gain 2 Socialize 3 Competition 4 Release tension 5 Enhance mental health 6 Keep fit 7 For the health of the baby 8 For my health 9 Other
Past Pregnancy - Diet Habits			
129	pp_diet_chang Show the field ONLY if: [dob_chd] = '1'	Did your eating habits change at all during your past pregnancy? Example: Poor eating habits may include eating less healthy foods, skipping meals, late night snacking etc.	radio 1 My eating habits became less healthy 2 My eating habits stayed the same 3 My eating habits became more healthy 4 I don't know
130	pp_diet_progre Show the field ONLY if: [dob_chd] = '1'	As your pregnancy progressed, did your eating habits change?	radio 1 Yes, I ate more as my pregnancy progressed 2 Yes, I ate less as my pregnancy progressed 3 No, my eating habits stayed relatively the same 4 I don't know
131	preg_cfg2 Show the field ONLY if: [dob_chd] = '1'	Did you follow Canada's Food Guide while pregnant?	radio 1 Never 2 Rarely

			3 Sometimes 4 Often 5 All of the Time 6 I don't/ didn't know Canada's Food Guide 7 I was aware of Canada's Food Guide but not sure if I followed it
132	pp_natfg Show the field ONLY if: [dob_chd] = '1' and[cnty_prenatcr] = '3' and[cnty_prenatcr] = '2'	Did you follow your national food guide while pregnant?	radio 1 Never 2 Rarely 3 Sometimes 4 Often 5 All of the Time 6 There is no national food guide available 7 I was aware of our national food guide but not sure if I followed it
133	diet_changes_htlhcr2_445 Show the field ONLY if: [dob_chd] = '1'	Did your health care provider discuss any necessary diet changes you should make during your past pregnancy (calorie changes, vitamin requirements etc.)?"	yesno 1 Yes 0 No
134	pp_diet_hlthcr_advce Show the field ONLY if: [dob_chd] = '1' and[diet_changes_htlhcr2_445] = '1'	What was the dietary advice given to you from your health care provider during pregnancy?	radio 1 To eat more 2 To eat the same 3 To eat less
135	kcal_req_amt2ad Show the field ONLY if: [dob_chd] = '1'	If your health care provider suggested you eat more or less, did they give you any specific advice? <i>Please describe</i>	text
136	alc_preg Show the field ONLY if: [dob_chd] = '1'	Did you consume any alcoholic beverages at any point during pregnancy?	radio 1 Every day 2 2-3 times a week 3 Once a week 4 Once every 2-3 wks 5 Once a month 6 On special occasions only 7 Never 8 Prefer not to answer
137	smok_preg Show the field ONLY if: [dob_chd] = '1'	Did you smoke cigarettes at any point during pregnancy? <i>Do not include tobacco smoke during traditional ceremonies</i>	radio 1 Every day 2 2-3 times a week

			3 Once a week 4 Once every 2-3 wks 5 Once a month 6 On special occasions only 7 Never 8 Prefer not to answer
138	preg_supp Show the field ONLY if: [dob_chd] = '1'	Did you take any supplements during pregnancy? Including prenatal supplements.	yesno 1 Yes 0 No
139	pp_prenat_no Show the field ONLY if: [prenat] = '2'	If no, why are you currently not taking a prenatal vitamin?	radio 1 Personal choice 2 Prenatal vitamins are too expensive 3 I don't know where to get them 4 I believe they are unnecessary 5 I didn't know it was needed 6 Other
Past Pregnancy - Health/ Birth			
140	prenatclass_locat Show the field ONLY if: [dob_chd] = '1'	Did you attend prenatal or childbirth education class (es) for your most recent past pregnancy? You may choose more than one location if multiple classes were attended. <i>Feel free to check more than one option</i>	checkbox 1 Hospital 2 Health Clinic 3 Community Center 4 Privately (such as with a midwife or doula) 5 Other 6 No, I did not attend any classes 7 I attended classes for another past pregnancy so there was no need to attend more.
141	newmed Show the field ONLY if: [dob_chd] = '1'	Did any new medical condition(s) develop during your previous pregnancy?	radio 1 Yes 2 No 3 Unsure 4 Prefer not to answer
142	gest_dia Show the field ONLY if: [dob_chd] = '1'	Were you diagnosed with gestational diabetes?	radio 1 Yes 2 No 3 Unsure 4 Prefer not to answer
143	prec_hbp Show the field ONLY if: [dob_chd] = '1'	Were you diagnosed with preeclampsia or high blood pressure in pregnancy?	radio 1 Yes 2 No

			3 Unsure 4 Prefer not to answer
144	medcond_y Show the field ONLY if: [newmed] = '1'	please describe your new medical condition(s) that developed during your previous pregnancy:	text
145	birth_cnr Show the field ONLY if: [dob_chd] = '1'	In what type of centre did you give birth?	radio 1 Home 2 Birth centre 3 Hospital 4 Other
146	delv_mod Show the field ONLY if: [dob_chd] = '1'	What was the method of delivery? (C-section, vaginal, VBAC)	radio 1 Vaginal birth 2 C-section 3 Vaginal with forceps or vacuum 4 Vaginal birth after C-section
147	induc_lab Show the field ONLY if: [dob_chd] = '1'	Was your labour induced?	radio 1 Yes 2 No 3 Prefer not to answer 4 Don't know
148	bstfd Show the field ONLY if: [dob_chd] = '1'	Did you try to breastfeed your baby?	yesno 1 Yes 0 No
149	brstf_y Show the field ONLY if: [dob_chd] = '1' and[bstfd] = '1'	How long after birth did you begin breastfeeding?	radio 1 Immediately 2 Less than 30 minutes 3 2 hours to less than 12 hours 4 12 hours to less than 24 hours 5 24 hours or more 6 I don't know 7 I tried to breastfed but was unsuccessful
150	not_brstfd Show the field ONLY if: [dob_chd] = '1'	What was your child fed after birth, once arriving home?	radio 1 Breast milk, from breast 2 Breast milk, pumped 3 Formula 5 Both formula and breast milk 4 Other
151	brfd_ex Show the field ONLY if: [bstfd] = '1'	How many months did you exclusively breastfeed (number of months)?	dropdown 1 1 2 2 3 3

			4 4 5 5 6 6 7 7 8 8 9 9 10 10 11 11 12 12 13 More than 12
152	form_ex2 Show the field ONLY if: [bstfd] = '3'	How many months did you exclusively formula feed (number of months before introduction of other foods)?	dropdown 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 10 10 11 11 12 12 13 More than 12
153	brstfd_month Show the field ONLY if: [bstfd] = '1'	How many months did you breastfeed (non-exclusively)? (Breastfeed with other foods added into infants diet) <i>e.g., 8</i>	text (integer, Min: 0, Max: 50)
154	brstsupport Show the field ONLY if: [dob_chd] = '1'	Did your health care provider(s) give you information about community breastfeeding support resources for ongoing help?	radio 1 Yes 2 No
All Women - Pregnancy Diet Perception/ Knowledge			
155	kcal_req_changetri	Do you know the approximate caloric intake change for pregnant women? (e.g., pregnant women need how many additional calories per day)	yesno 1 Yes 0 No
156	kcal_req_amt3	Does the amount of food you eat change depending on how far along you are in your pregnancy (what	yesno 1 Yes 0 No

		trimester you are in)?	
157	kcal_req_partrept2_12b Show the field ONLY if: [kcal_req_amt3]= '0'	Please specify the calorie (kcal) amount change (additional calories needed per day while pregnant). Please enter just the number. <i>amount of additional kcal per day during pregnancy</i>	text (integer, Min: 0, Max: 2000)
158	kcal_req_tri1 Show the field ONLY if: [kcal_req_amt3]= '1'	Please specify the calorie (kcal) amount change (additional calories needed per day while pregnant). During the FIRST trimester. Enter just the number (no dashes, spaces etc.) <i>amount of additional kcal per day</i>	text (integer, Min: 0, Max: 2000)
159	kcal_req_tri2 Show the field ONLY if: [kcal_req_amt3]= '1'	Please specify the calorie (kcal) amount change (additional calories needed per day while pregnant). During the SECOND trimester (just the number, no dashes, spaces etc.). <i>amount of additional kcal per day</i>	text (integer, Min: 0, Max: 2000)
160	kcal_req_tri3 Show the field ONLY if: [kcal_req_amt3]= '1'	Please specify the calorie (kcal) amount change (additional calories needed per day while pregnant). During the THIRD trimester (just the number, no dashes, spaces etc.). <i>amount of additional kcal per day</i>	text (integer, Min: 0, Max: 2000)
161	kcal_changes2_ecc	Does it surprise you to know that pregnant women require ZERO additional calories during their first trimester?	yesno 1 Yes 0 No
162	kcal_changes2	Does it surprise you to know that women need 340 additional calories (kcal) per day throughout their second trimester of pregnancy? <i>kcal examples: Medium sized apple = 72 kcal, bagel = 289 kcal, one slice of bread = 66 kcal</i>	radio 1 No, this change does not surprise me 2 Yes, the kcal change is a little LESS than I thought 3 Yes, the kcal change is a lot LESS than I thought 4 Yes, The kcal change is a little MORE than I thought 5 Yes, the kcal change is a lot MORE than I thought 6 I prefer not to answer 7 I don't know

163	kcal_changes3	Does it surprise you to know that women need 450 additional calories (kcal) per day throughout their third trimester of pregnancy? <i>kcal examples: Medium sized apple = 72 kcal, bagel = 289 kcal, one slice of bread = 66 kcal</i>	radio 1 No, this change does not surprise me 2 Yes, the kcal change is a little LESS than I thought 3 Yes, the kcal change is a lot LESS than I thought 4 Yes, The kcal change is a little MORE than I thought 5 Yes, the kcal change is a lot MORE than I thought 6 I prefer not to answer 7 I don't know
164	kcal_change_expln2_f29 Show the field ONLY if: [kcal_changes2_ecc] = '1' and[kcal_changes2] = '2' and[kcal_changes2] = '3' and[kcal_changes2] = '4' and[kcal_changes2] = '5' and[kcal_changes3] = '2' and[kcal_changes3] = '3' and[kcal_changes3] = '4' and[kcal_changes3] = '5'	You have stated that the caloric changes do surprise you. Please explain.	radio 1 It's a lot less than you thought 2 It's a little less than you thought 3 It's a lot more than you thought 4 It's a little more than you thought 5 I prefer not to answer 6 I don't know
All Women – Weight Perception/ Knowledge/ Beliefs			
165	att_1	Do/ Did you worry that you may gain too much weight while pregnant?	radio 1 Never 2 Occasionally 3 Sometimes 4 Frequently 5 Always
166	att_2	Do/ Did you feel it is acceptable to gain as much weight as you want while you are pregnant?	radio 1 Yes, I strongly agree 2 Yes, I Agree 3 Not sure 4 No, I disagree 5 No, I strongly disagree
167	att_3	As long as you are eating a well-balanced, healthy diet, do you feel it shouldn't matter how much weight you gain while you're pregnant?	radio 1 Yes, I strongly agree 2 Yes, I Agree 3 Not sure 4 No, I disagree 5 No, I strongly disagree
168	att_4	Do you think that women should be	radio

		careful about gaining too much weight during pregnancy?	1 Yes, I strongly agree 2 Yes, I Agree 3 Not sure 4 No, I disagree 5 No, I strongly disagree
169	dis_wtgn	How comfortable do/ did you feel discussing your weight and/or weight gain during pregnancy with your health care provider?	radio 1 Very uncomfortable 2 Uncomfortable 3 Comfortable 4 Very comfortable 5 Prefer not to answer
170	dis_wtgn_ff	How comfortable do/did you feel discussing your weight and/or weight gain during pregnancy with friends or family members?	radio 1 Very uncomfortable 2 Uncomfortable 3 Comfortable 4 Very comfortable 5 Prefer not to answer
171	underwt_wtgain2_most Show the field ONLY if: [dob_chd] = '1' and[cntly_preg] = '2'	I would feel MOST comfortable gaining the following amount if I were to become pregnant:	radio 1 Less than 5 kg (11 lbs) 2 5-9 kg (11- 20 lbs) 3 7-11.5 kg (15-25 lbs) 4 11.5-16 kg (25-35 lbs) 5 12.5-18 kg (28-40 lbs) 6 More than 18 kg (40 lbs) 7 Any amount of weight gain is healthy during pregnancy 8 Prefer not to answer
172	wtgn_why Show the field ONLY if: [underwt_wtgain2_most] = '1' or[underwt_wtgain2_most] = '2' or[underwt_wtgain2_most] = '3' or[underwt_wtgain2_most] = '4' or[underwt_wtgain2_most] = '5' or[underwt_wtgain2_most] = '6' or[underwt_wtgain2_most] = '7'	Why would you feel most comfortable gaining this amount while pregnant?	radio 1 I believe it is a healthy amount to gain while pregnant 2 My friends and family told me this is a good amount 3 My health care provider told me this is a good amount 4 My significant other/partner told me this is a good amount 5 I'm not concerned with how much I gain while I'm pregnant 6 Other
173	loc_1	I am able to control the amount of	radio

		weight that I gain while pregnant	1 Strongly agree 2 Agree 3 Not sure 4 Disagree 5 Strongly disagree
174	loc_2	If I am healthy and exercise, I can control my weight while pregnant.	radio 1 Strongly agree 2 Agree 3 Not sure 4 Disagree 5 Strongly disagree
175	se_3	Although you may have many obligations that take a lot of time from your day (i.e. family, friends or work), do you feel that you can still be physically active?	yesno 1 Yes 0 No
176	se_1	When you are pregnant, do you feel that you can eat healthy foods and avoid foods that aren't good for you?	yesno 1 Yes 0 No
177	se_2 Show the field ONLY if: [se_1]= '0' or[se_1]= '1'	Would this change if you were not pregnant?	yesno 1 Yes 0 No
178	diet	Do you currently follow a specific diet? <i>Feel free to choose multiple answers</i>	checkbox 1 diet__1 Vegetarian 2 diet__2 Vegan 3 diet__3 Gluten free 4 diet__4 Low calorie 5 diet__5 Low sodium 6 diet__6 Low sugar 7 diet__7 High protein 8 diet__8 No, I don't follow a specific diet
179	diet_preg	If yes, did you follow this diet while you were pregnant? If you are currently pregnant, are you following this diet now?	yesno 1 Yes 0 No
All women – Perceived weight gain Facilitators/ Barriers			
180	gwg_barr	What do you believe are the barriers to gaining within a targeted weight during pregnancy? <i>Feel free to choose multiple answers</i>	checkbox 1 gwg_barr__1 Lack of support from family or friends 2 gwg_barr__2 Lack of guidance from health care

			professional 3 gwg_barr___3 Weight gain during pregnancy is beyond control of the mother 4 gwg_barr___4 It is difficult to exercise during pregnancy 5 gwg_barr___5 It is difficult to eat healthy during pregnancy 6 gwg_barr___6 I don't believe there are any barriers to gaining a healthy amount of weight during pregnancy. 7 gwg_barr___7 Other
181	gwg_facil	What do you believe contributes to women being able to gain within a targeted weight during pregnancy? <i>Feel free to choose multiple answers</i>	checkbox 1 gwg_facil___1 Support from family or friends 2 gwg_facil___2 Guidance from health care professional 3 gwg_facil___3 Weight gain management during pregnancy is a priority for me 4 gwg_facil___4 I get regular exercise during pregnancy 5 gwg_facil___5 I eat healthy during pregnancy 6 gwg_facil___6 Other
All Women – Social Support / Guidance			
182	sn_1	Have any of your friends or family members been pregnant since May 2009?	radio 1 I have family members who have been pregnant in the past 5 years 2 I have friends who have been pregnant in the past 5 years 3 I have family members AND friends who have been pregnant in the past 5 years 4 No, I don't have any friends or family members who have been pregnant in the past 5 years
183	sn_2 Show the field ONLY if: [sn_1] = '1' or [sn_1] = '3'	If yes, consider your most recent friend who was pregnant, how much weight, on average, did she gain	radio 1 Less than 15 lbs (7 kg) 2 15-24 lbs (7-11 kg)

		while pregnant?	3 25-34 lbs (11-15 kg) 4 35-44 lbs (15-20 kg) 5 45-54 lbs (20-25 kg) 6 55-64 lbs (25-30 kg) 7 65-74 lbs (30-34 kg) 8 More than 75 lbs (35 kg) 9 I don't know
184	sn_3 Show the field ONLY if: [sn_1] = '3' or [sn_1] = '2'	If yes, consider your most recent family member who was pregnant, how much weight, on average, did she gain while pregnant?	radio 1 Less than 15 lbs (7 kg) 2 15-24 lbs (7-11 kg) 3 25-34 lbs (11-15 kg) 4 35-44 lbs (15-20 kg) 5 45-54 lbs (20-25 kg) 6 55-64 lbs (25-30 kg) 7 65-74 lbs (30-34 kg) 8 More than 75 lbs (35 kg) 9 I don't know
185	sn_4	Is this a similar amount of pregnancy weight gained by other friends / family members?	radio 1 Yes they gain similar amounts 2 No most gain more weight 3 No, most gain less weight
186	sn_frids Show the field ONLY if: [sn_1] = '1' or '2' or '3'	How do you feel about the amount of weight they gained while pregnant?	radio 1 They gained far too much weight 2 They gained too much weight 3 They gained a healthy amount of weight 4 They gained too little weight 5 They gained far too little weight
187	sn_adv	Did you receive advice from your family or friends about how much weight to gain while pregnant?	radio 1 Yes, weight gain advice from family members 2 Yes, weight gain advice from friends 3 Yes, weight gain advice from family members AND friends 4 No, I didn't get any weight gain advice from friends or family members
188	sn_trust	Whose advice do you trust the MOST (in regards to weight gain while pregnant)?	radio 1 Family members (parents, siblings) 2 Friends 3 Significant other/partner 4 Advice from my health care provider
187	sn_adv	Did you receive advice from your	radio

		family or friends about how much weight to gain while pregnant?	1 Yes, weight gain advice from family members 2 Yes, weight gain advice from friends 3 Yes, weight gain advice from family members AND friends 4 No, I didn't get any weight gain advice from friends or family members
188	sn_trust	Whose advice do you trust the MOST (in regards to weight gain while pregnant)?	radio 1 Family members (parents, siblings) 2 Friends 3 Significant other/partner 4 Advice from my health care provider

All Women – BMI calculated GWG target weight gain perceptions

189	underwt_wtgain_1 Show the field ONLY if: (((initial_arm_1)[bmi_lbsin] < "18.5" and[initial_arm_1][bmi_lbsin] <> "")) or (((initial_arm_1)[bmi_kgcm] < "18.5" and[initial_arm_1][bmi_kgcm] <> "")) and[initial_arm_1][cntly_preg] = '1' and[initial_arm_1][dob_chd] = '0'	Based on the pre-pregnancy height and weight you provided, your pregnancy weight gain should be between 12.5-18 kg (28-40 lbs). Is this higher, lower or about the same amount of what you would have expected?	radio <table><tr><td>1</td><td>Higher</td></tr><tr><td>2</td><td>Lower</td></tr><tr><td>3</td><td>About the same</td></tr></table>	1	Higher	2	Lower	3	About the same
1	Higher								
2	Lower								
3	About the same								
190	normwt_wtgain2 Show the field ONLY if: (((initial_arm_1)[bmi_lbsin] >= "18.5" and[initial_arm_1][bmi_lbsin] <= "24.9" and[initial_arm_1][bmi_lbsin] <> "") or (((initial_arm_1)[bmi_kgcm] >= "18.5" and[initial_arm_1][bmi_kgcm] <= "24.9" and[initial_arm_1][bmi_kgcm] <> "")) and[initial_arm_1][cntly_preg] = '1' and[initial_arm_1][dob_chd] = '0'	Based on the pre-pregnancy height and weight you provided, your pregnancy weight gain should be between 11.5-16 kg (25-35 lbs). Is this higher, lower or about the same amount of what you would have expected?	radio <table><tr><td>1</td><td>Higher</td></tr><tr><td>2</td><td>Lower</td></tr><tr><td>3</td><td>About the same</td></tr></table>	1	Higher	2	Lower	3	About the same
1	Higher								
2	Lower								
3	About the same								
191	overwt_wtgain2 Show the field ONLY if:	Based on the pre-pregnancy height and weight you provided, your	radio						

	([initial_arm_1][bmi_lbsin] >= "25" and[initial_arm_1][bmi_lbsin] <= "29.9" and[initial_arm_1][bmi_lbsin] <> "") or ([initial_arm_1][bmi_kgcm] >= "25" and[initial_arm_1][bmi_kgcm] <= "29.9" and[initial_arm_1][bmi_kgcm] <> "")) and[initial_arm_1][cntly_preg] = '1' and[initial_arm_1][dob_chd] = '0'	pregnancy weight gain should be between 6-11 kg (15-25 lbs). Is this higher, lower or about the same amount of what you would have expected?	1Higher 2Lower 3About the same
192	obese_wtgain2 Show the field ONLY if: (((initial_arm_1)[bmi_lbsin] > "30" and[initial_arm_1][bmi_lbsin] <> "")) or ((initial_arm_1)[bmi_kgcm] > "30" and[initial_arm_1][bmi_kgcm] <> "")) and[initial_arm_1][cntly_preg] = '1' and[initial_arm_1][dob_chd] = '0'	Based on the pre-pregnancy height and weight you provided, your pregnancy weight gain should be between 5-9 kg (11-20 lbs). Is this higher, lower or about the same amount of what you would have expected?	radio 1Higher 2Lower 3About the same
193	underwt_wtgain2 Show the field ONLY if: (((initial_arm_1)[bmi_lbsin] < "18.5" and[initial_arm_1][bmi_lbsin] <> "")) or ((initial_arm_1)[bmi_kgcm] < "18.5" and[initial_arm_1][bmi_kgcm] <> "")) and[initial_arm_1][cntly_preg] = '2' and[initial_arm_1][dob_chd] = '1'	Based on the height and weight you provided, if you were to become pregnant, your pregnancy weight gain target would be between 12.5-18 kg (28-40 lbs). Is this higher, lower or about the same amount of what you would have expected?	radio 7Higher 8Lower 9About the same
194	underwt_wtgain Show the field ONLY if: ([initial_arm_1][bmi_lbsin] >= "18.5" and[initial_arm_1][bmi_lbsin] <> "") or ([initial_arm_1][bmi_kgcm] >= "18.5" and[initial_arm_1][bmi_kgcm] <> "") and[initial_arm_1][cntly_preg] = '2' and[initial_arm_1][dob_chd] = '1'	Based on the height and weight you provided, if you were to become pregnant, your pregnancy weight gain target would be between 11.5-16 kg (25-35 lbs).	radio 7Higher 8Lower

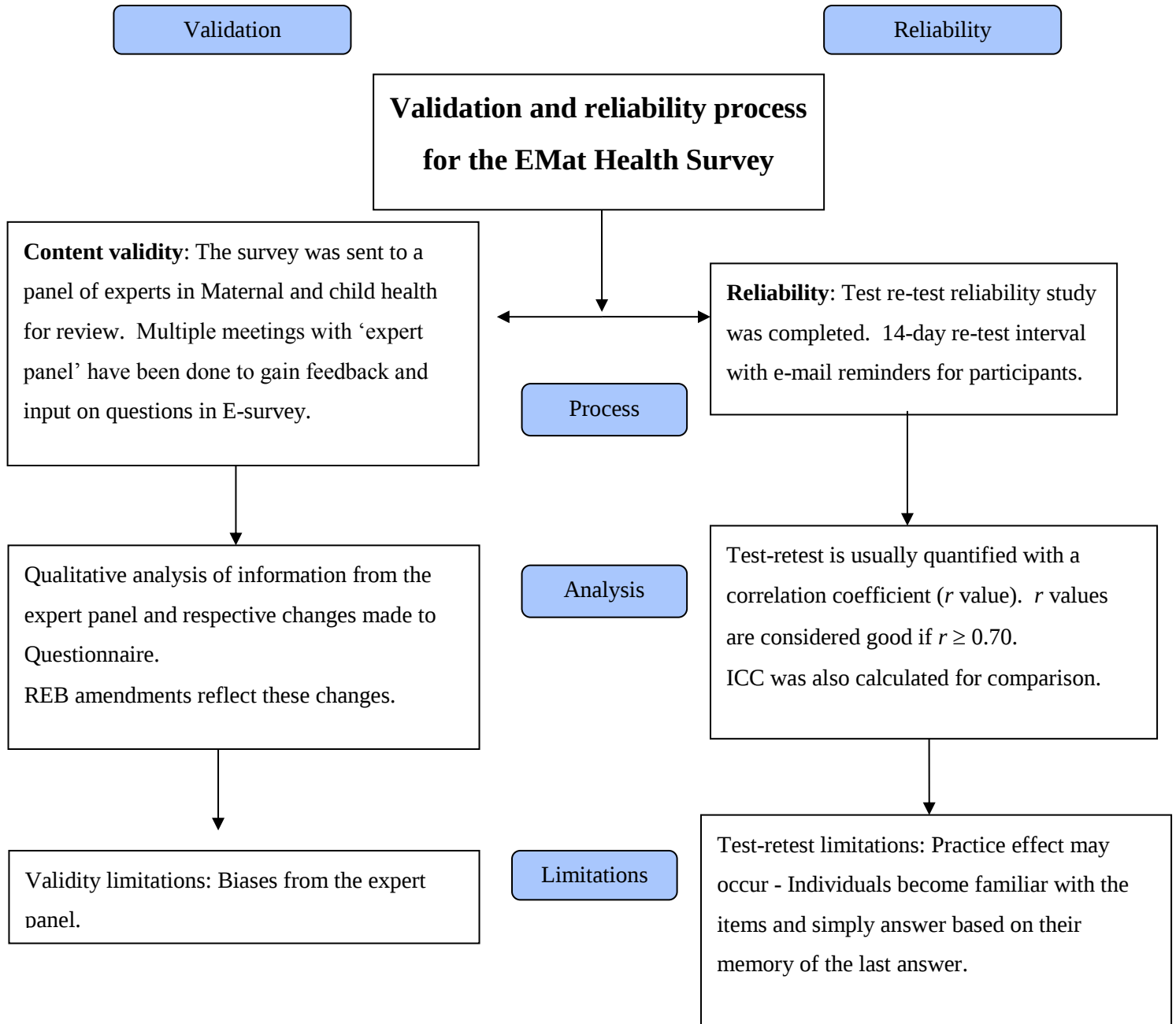
	bsin] <= "24.9" and[initial_arm_1][bmi_lb bsin] <> "") or ([initial_arm_1][bmi_kgc m] >= "18.5" and[initial_arm_1][bmi_ kgcm] <= "24.9" and[initial_arm_1][bmi_ kgcm] <> "") and[initial_arm_1][cntly _preg] = '2' and[initial_arm_1][dob_ chd] = '1'	Is this higher, lower or about the same amount of what you would have expected?	9	About the same
195	underwt_wtgain3 Show the field ONLY if: ([initial_arm_1][bmi_lbsi n] >= "25" and[initial_arm_1][bmi_lb bsin] <= "29.9" and[initial_arm_1][bmi_lb bsin] <> "") or ([initial_arm_1][bmi_kgc m] >= "25" and[initial_arm_1][bmi_ kgcm] <= "29.9" and[initial_arm_1][bmi_ kgcm] <> "") and[initial_arm_1][cntly _preg] = '2' and[initial_arm_1][dob_ chd] = '1'	Based on the height and weight you provided, if you were to become pregnant , your pregnancy weight gain target would be between 6-11.5 kg (15-25 lbs). Is this higher, lower or about the same amount of what you would have expected?	radio	7 Higher 8 Lower 9 About the same
196	underwt_wtgain4 Show the field ONLY if: ([initial_arm_1][bmi_lb sin] > "30" and[initial_arm_1][bmi_lb bsin] <> "") or ([initial_arm_1][bmi_kgc m] > "30" and[initial_arm_1][bmi_ kgcm] <> "") and[initial_arm_1][cntly _preg] = '2' and[initial_arm_1][dob_ chd] = '1'	Based on the height and weight you provided, if you were to become pregnant, your pregnancy weight gain target would be between 5-9 kg (11-20 lbs) . Is this higher, lower or about the same amount of what you would have expected?	radio	7 Higher 8 Lower 9 About the same
197	gwg_target2_68a Show the field ONLY if: [underwt_wtgain_1] = '1' or[underwt_wtgain_1] =	Do you think this weight gain amount is a realistic target for you?	radio	1 Yes

	'2' or[underwt_wtgain_1] = '3' or[normwt_wtgain2] = '1' or[normwt_wtgain2] = '2' or[normwt_wtgain2] = '3' or[normwt_wtgain2] = '3' or[overwt_wtgain2] = '1' or[overwt_wtgain2] = '2' or[obese_wtgain2] = '1' or[overwt_wtgain2] = '3' or[obese_wtgain2] = '2' or[obese_wtgain2] = '3' or[underwt_wtgain2] = '7' or[underwt_wtgain2] = '8' or[underwt_wtgain2] = '9' or[underwt_wtgain] = '7' or[underwt_wtgain] = '8' or[underwt_wtgain3] = '9' or[underwt_wtgain4] = '9' or[underwt_wtgain4] = '8' or[underwt_wtgain4] = '7'		<table><tr><td>2</td><td>No</td></tr><tr><td>3</td><td>I don't know</td></tr><tr><td>4</td><td>Prefer not to answer</td></tr></table>	2	No	3	I don't know	4	Prefer not to answer		
2	No										
3	I don't know										
4	Prefer not to answer										
198	kcal_changes2_ecc	Does it surprise you to know that pregnant women require ZERO additional calories during their first trimester?	yesno <table><tr><td>1</td><td>Yes</td></tr><tr><td>0</td><td>No</td></tr></table>	1	Yes	0	No				
1	Yes										
0	No										
199	kcal_changes2	Does it surprise you to know that women need 340 additional calories (kcal) per day throughout their second trimester of pregnancy? kcal examples: Medium sized apple = 72 kcal, bagel = 289 kcal, one slice of bread = 66 kcal	radio <table><tr><td>1</td><td>No, this change does not surprise me</td></tr><tr><td>2</td><td>Yes, the kcal change is a little LESS than I thought</td></tr><tr><td>3</td><td>Yes, the kcal change is a lot LESS than I thought</td></tr><tr><td>4</td><td>Yes, The kcal change is a little</td></tr></table>	1	No, this change does not surprise me	2	Yes, the kcal change is a little LESS than I thought	3	Yes, the kcal change is a lot LESS than I thought	4	Yes, The kcal change is a little
1	No, this change does not surprise me										
2	Yes, the kcal change is a little LESS than I thought										
3	Yes, the kcal change is a lot LESS than I thought										
4	Yes, The kcal change is a little										

			<table><tr><td></td><td>MORE than I thought</td></tr><tr><td>5</td><td>Yes, the kcal change is a lot MORE than I thought</td></tr><tr><td>6</td><td>I prefer not to answer</td></tr><tr><td>7</td><td>I don't know</td></tr></table>		MORE than I thought	5	Yes, the kcal change is a lot MORE than I thought	6	I prefer not to answer	7	I don't know								
	MORE than I thought																		
5	Yes, the kcal change is a lot MORE than I thought																		
6	I prefer not to answer																		
7	I don't know																		
200	kcal_changes3	Does it surprise you to know that women need 450 additional calories (kcal) per day throughout their third trimester of pregnancy? kcal examples: Medium sized apple = 72 kcal, bagel = 289 kcal, one slice of bread = 66 kcal	<table><tr><td colspan="2">radio</td></tr><tr><td>1</td><td>No, this change does not surprise me</td></tr><tr><td>2</td><td>Yes, the kcal change is a little LESS than I thought</td></tr><tr><td>3</td><td>Yes, the kcal change is a lot LESS than I thought</td></tr><tr><td>4</td><td>Yes, The kcal change is a little MORE than I thought</td></tr><tr><td>5</td><td>Yes, the kcal change is a lot MORE than I thought</td></tr><tr><td>6</td><td>I prefer not to answer</td></tr><tr><td>7</td><td>I don't know</td></tr></table>	radio		1	No, this change does not surprise me	2	Yes, the kcal change is a little LESS than I thought	3	Yes, the kcal change is a lot LESS than I thought	4	Yes, The kcal change is a little MORE than I thought	5	Yes, the kcal change is a lot MORE than I thought	6	I prefer not to answer	7	I don't know
radio																			
1	No, this change does not surprise me																		
2	Yes, the kcal change is a little LESS than I thought																		
3	Yes, the kcal change is a lot LESS than I thought																		
4	Yes, The kcal change is a little MORE than I thought																		
5	Yes, the kcal change is a lot MORE than I thought																		
6	I prefer not to answer																		
7	I don't know																		
201	kcal_change_expln2_f29 Show the field ONLY if: [kcal_changes2_ecc] =	You have stated that the caloric changes do surprise you. Please explain.	<table><tr><td colspan="2">radio</td></tr></table>	radio															
radio																			

	'1' and[kcal_changes2] = '2' and[kcal_changes2] = '3' and[kcal_changes2] = '4' and[kcal_changes2] = '5' and[kcal_changes3] = '2' and[kcal_changes3] = '3' and[kcal_changes3] = '4' and[kcal_changes3] = '5'		<table><tr><td>1</td><td>It's a lot less than you thought</td></tr><tr><td>2</td><td>It's a little less than you thought</td></tr><tr><td>3</td><td>It's a lot more than you thought</td></tr><tr><td>4</td><td>It's a little more than you thought</td></tr><tr><td>5</td><td>I prefer not to answer</td></tr><tr><td>6</td><td>I don't know</td></tr></table>	1	It's a lot less than you thought	2	It's a little less than you thought	3	It's a lot more than you thought	4	It's a little more than you thought	5	I prefer not to answer	6	I don't know	
1	It's a lot less than you thought															
2	It's a little less than you thought															
3	It's a lot more than you thought															
4	It's a little more than you thought															
5	I prefer not to answer															
6	I don't know															

Appendix 8: Validation Flow-chart



Appendix 9: Reference List

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